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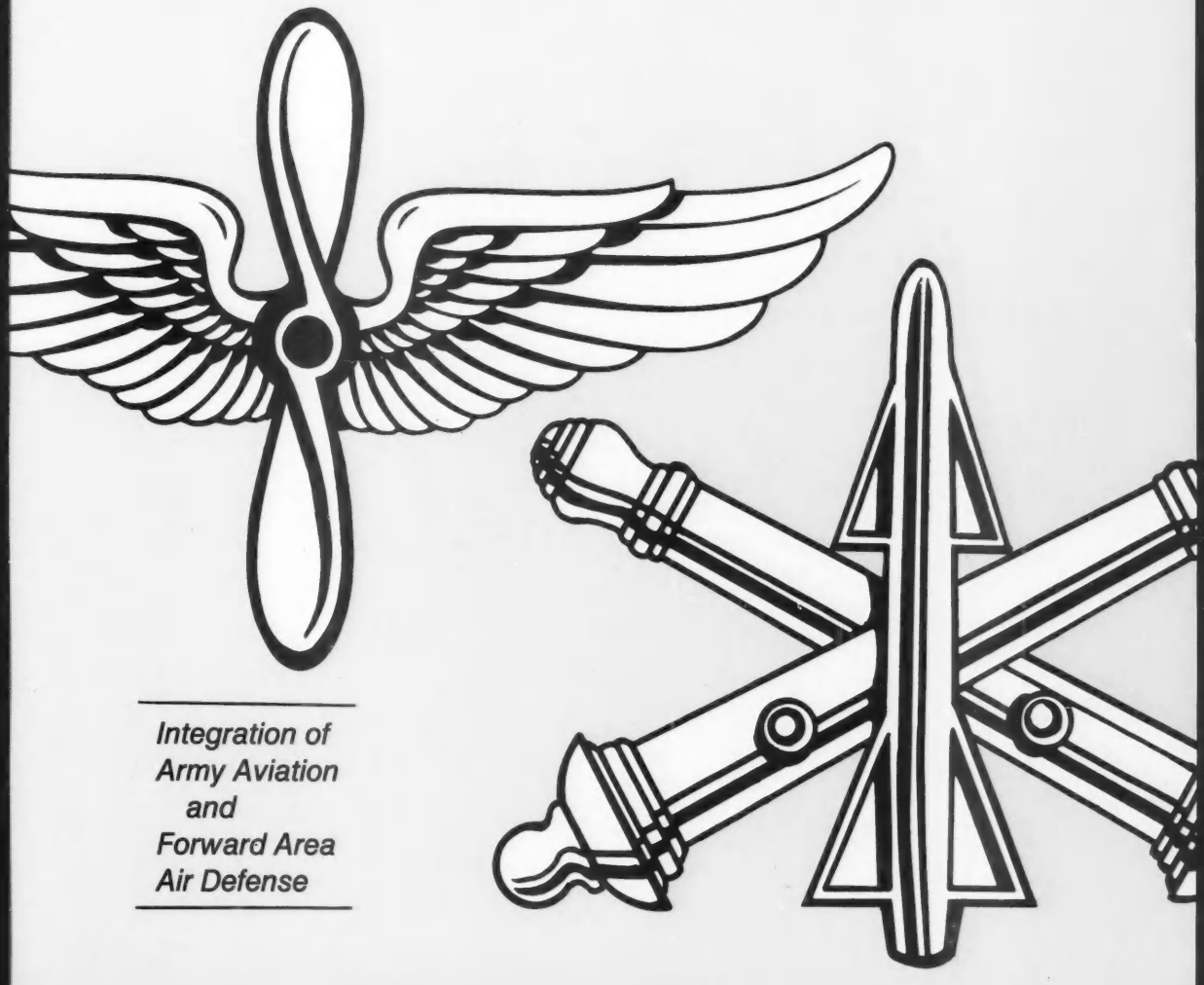
OCTOBER 1987

AVIATION DIGEST



Integration of Army Aviation and Forward Area Air Defense

Professional Bulletin 1-87-2

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PROFESSIONAL BULLETIN

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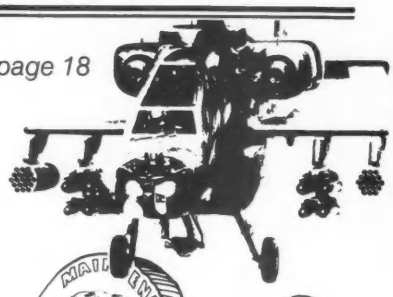

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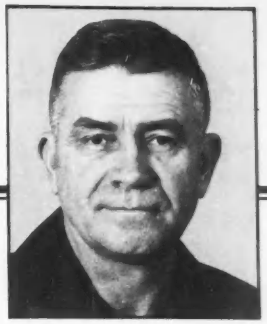
Major General Ellis D. Parker
Chief, Army Aviation Branch



Fly Safer at Night

RECENTLY, MANY of you were visited by teams consisting of individuals from U.S. Army Aviation Center Directorate of Evaluation/Standardization and the U.S. Army Safety Center. Their basic message was, "Fly safer at night." This is a relatively simple statement but, I assure you, not a simple task.

Aided night flight has evolved into an entirely new and challenging type of flying. We are flying more advanced aircraft with more advanced night-vision-enhancing systems than many of us ever dreamed was possible when we first entered aviation. Missions require nap-of-the-earth flight, moving troops, carrying external loads, providing covering forces, performing scout roles and so forth, all during darkness. We are doing it, and we are doing it well.

If we are doing it so well, you might wonder why there has been so much emphasis on safer night operations. Basically, it is an educational process. Much of our literature is slowly becoming dated; some of it has not been as definitive as it needs to be. Our technology, requirements and abilities are improving rapidly, and we are in the process of updating our documents to keep pace.

The Aviation Training Brigade at the Aviation Center is presently revising FM 1-204, "Night Flight Techniques and Procedures." A coordinating draft soon will be provided to the field for review. The Aviation Training Brigade is also updating all the aircrew training manuals; night and night vision goggles (NVG) considerations are being included in each of them.

This is not an easy task. It takes considerable time before a printed manual reaches the user. There are writes, rewrites, coordinating drafts, rewrites again and then the printing cycle. Please be patient. We are making every effort to expedite these manuals.

Many of you also have found improved ways to perform aided night missions, some of which have been adopted or are being tested for possible adoption. One example is the "GX-5" flip-up NVG mount. Approved by U.S. Army Aviation Systems Command for general use, this AN/PVS-5 mount improves peripheral vision and provides a flip-up capability when NVG are not needed or desired. Many more devices and techniques will be tested for possible use by all of us in the future. Your initiatives are inspiring.

The AN/AVS-6s are being fielded as fast as production will allow and as fast as Department of the Army can provide them according to the established priority list.

Work is ongoing at Ft. Rucker to resolve existing issues and new ones that are raised almost daily. Our ultimate goal is accident-free night operations. The aided/unaided night flight missions require our utmost attention and our unmatched flying skills, along with the most up-to-date doctrine and the best equipment we can buy.

In the interim, have patience and bear with us. We are doing everything as fast as we can. We invite all the ideas and assistance you, the field users, can provide. We will continually strive to provide the best.

Integrating Army Aviation and Forward Area Air Defense in the Counterair Mission

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*Lieutenant Colonel Cook was assigned to the Aviation Division when this article was written.

THE MORE ONE inspects the title of this article the more intrigued (or appalled?) one may become. A number of new elements make up the subject of this article—most of which would have seemed fairly radical even 2 or 3 years ago. First, we have a new Army Aviation Branch, which allows us to freely exploit innovative opportunities to the limits of our imagination using a new force aviation brigade structure, new aircraft and our AirLand Battle operational concept.

Second, we have now begun to develop a much more comprehensive, dedicated solution to the complex low level, tactical counterair problem with the four weapon system components and command, control and intelligence (C^2I) component of the new forward area air defense (FAAD) system.

Third, the Army Chief of Staff directed the U.S. Army Training and Doctrine Command "to lead and aggressively develop the operational concepts, doctrine and combat development initiatives" to afford the Army an air-to-air combat capability. U.S. Army aviators will now begin to have the capability to use fully the three dimensional operational envelope within which they operate.

Fourth, we have an opportunity to merge a number of surprisingly common requirements of our new Army Aviation Branch and FAAD concept resulting in a unique combined arms capability. The result will provide for greatly increased protection of our air and ground maneuver forces—synergy at its best.

There are a number of reasons why there should be a coordinated, integrated effort between FAAD and aviation forces as each contributes to a combined arms solution to the tactical, low level counterair mission.

- Eliminate fratricide.
- Exchange tipoff data.
- Handoff attrited threat aviation.
- Facilitate offensive/defensive maneuver control for friendly action.
- Provide for positive hostile identification for FAAD.
- Orchestrate the suppression of enemy air defenses (SEAD).
- Provide the commander a single, coordinated point of contact for counterair operations.

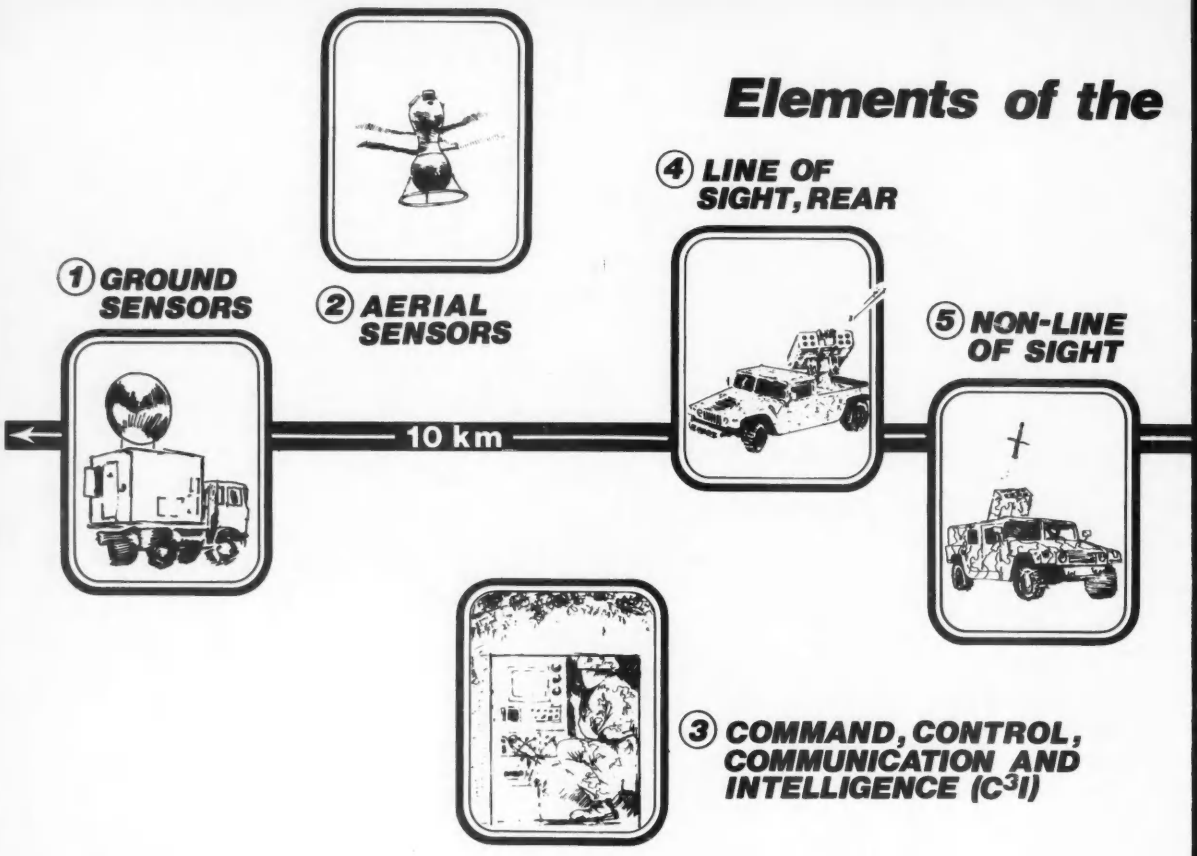
First, there have been a number of studies and analyses of recent conflicts that point out a critical problem area that tends to be overlooked by the peacetime aviator—fratricide. Sound menacing? It should. Some analyses indicate that potentially up to one out of three Army Aviation sorties, depending on the situation, could expect to be engaged mistakenly by our forward deployed air defense and ground forces in postulated mid- to high intensity conflict scenarios. Some recent history tends to corroborate this. The next time you see a TV news film clip of the Iranian-Iraqi War, note the 8 by 10 Iraqi flag insignia that the Iraqis have been forced to paint on both sides of their very distinctive Mi-24 Hinds in order to keep their ground forces from engaging their own helicopters. Once engaged by the Syrian Gazelle antitank helicopter in their most recent conflict, Israeli tankers were quite prone to then shoot at all helicopters, friendly included, and asked questions later.

As the new FAAD weapons and C^2I system are fielded, it is imperative that the Army Aviation community be coordinated into this effort in order to properly address the positive hostile identification issue. Not only will this increase FAAD and aviation combat effectiveness by allowing beyond visual range engagements, but it also will enhance our efforts to protect friendly aircraft.

Second, as operational Army Aviation task forces maneuver either defensively or offensively in support of either main battle area, rear area, flank or deep attack scenarios, it is to their mutual benefit that they exchange tipoff data concerning the activities and the movement of low flying Soviet Army aviation and Air Force tactical aircraft. In fact, U.S. Army Aviation forces can operate in any of the AirLand Battlefield areas. They can conduct either primary counterair roles or engaging targets "defensively" while guarding armor reserve movement, air assault forces or joint air attack teams. They could handoff attrited threat aviation forces to our FAAD systems as we intend to handoff attrited second echelon armor forces to our primary antiarmor defenses along the forward line of own troops (FLOT). Team work at its best!

Third, there are a number of other advantages to an integrated FAAD/aviation counterair effort. Aviation forces planning and executing air defense suppression missions (remember this is the neglected other half of our extremely high priority aviation mission area deficiency, usually addressed only in terms of our lack of an air-to-air (ADA) capability) should use ADA expertise when available in orchestrating these highly technical, complex missions as part of our overall electronic and lethal countermeasures program. Finally, we must absolutely ensure that the necessary control measures are used so that we retain the freedom to exploit the strongest, most unique characteristic of our aviation force, its *mobility*, without hindering our new FAAD system's ability to employ its weapons freely to the maximum effective ranges.

There are several critical issues surrounding Army air and ground forces working together to execute a low level counterair program. First, a combined arms weapons mix of both dedicated air defense systems and air defense capable aviation and ground weapon systems is absolutely essential (for the entire counterair effort as well as per individual system if possible!). Elements of the FAAD system will integrate their fires with those of supported ground forces, both the armored combat vehicle organic weapons and the massed small arms fires of our infantry (one of the greatest killers of low flying

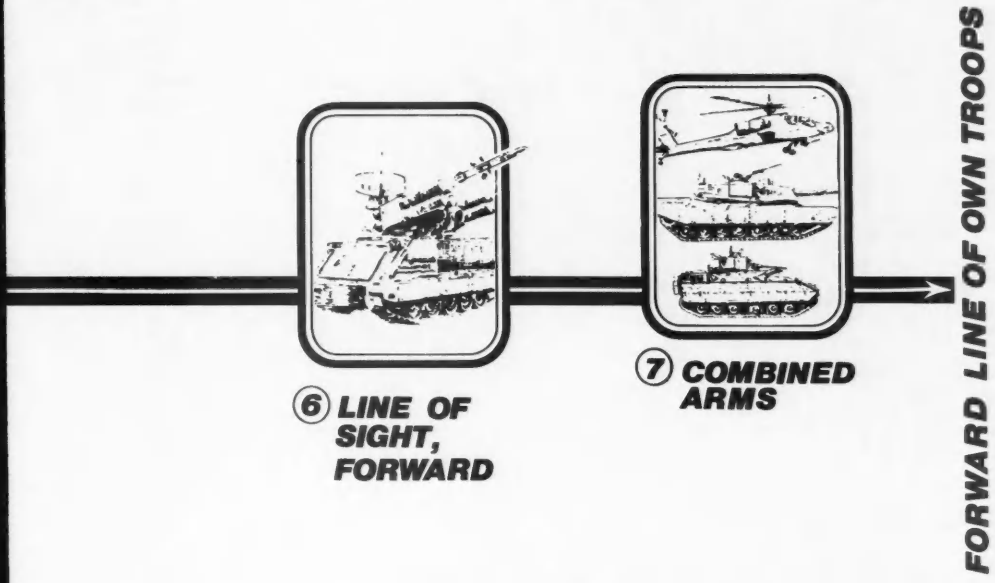


aircraft in World War II). In areas not heavily covered by FAAD systems, usually the flanks and rear areas, Army Aviation assets normally will be in a position to provide either primary or on order mission support. As aviation task forces maneuver across the FLOT, proper SEAD planning and execution along with timely identification and tipoff of threat airborne interceptor operations will be mandatory.

Perhaps the most important point to make is that the effectiveness of all these weapons systems is dependent on the use of a well integrated command, control, communications and intelligence (C^3I) system. As envisioned, the FAAD C^2I system will incorporate a suite of ground and aerial sensors linked to a real-time command and control system using the Army data distribution system (Enhanced Position Locating and Reporting Systems/Joint Tactical Information Distribution System). This fully funded and approved development program will make use of the latest technologies in order to field a modern, sophisticated acquisition, identification and tracking system.

A prime objective of this C^3I system is to fuse information from an all-source surveillance and intelligence base and to distribute this real-time data to all of the users in the system. The FAAD process is on schedule in the execution of this priority requirement. Aviation as a new branch, expanding and exploring new options and opportunities, is in an operationally and economically prudent position to work closely with the ongoing FAAD initiative, particularly with the FAAD aerial sensor project. We cannot assume that the current 40-year-old aviation line-of-sight voice commo system operating

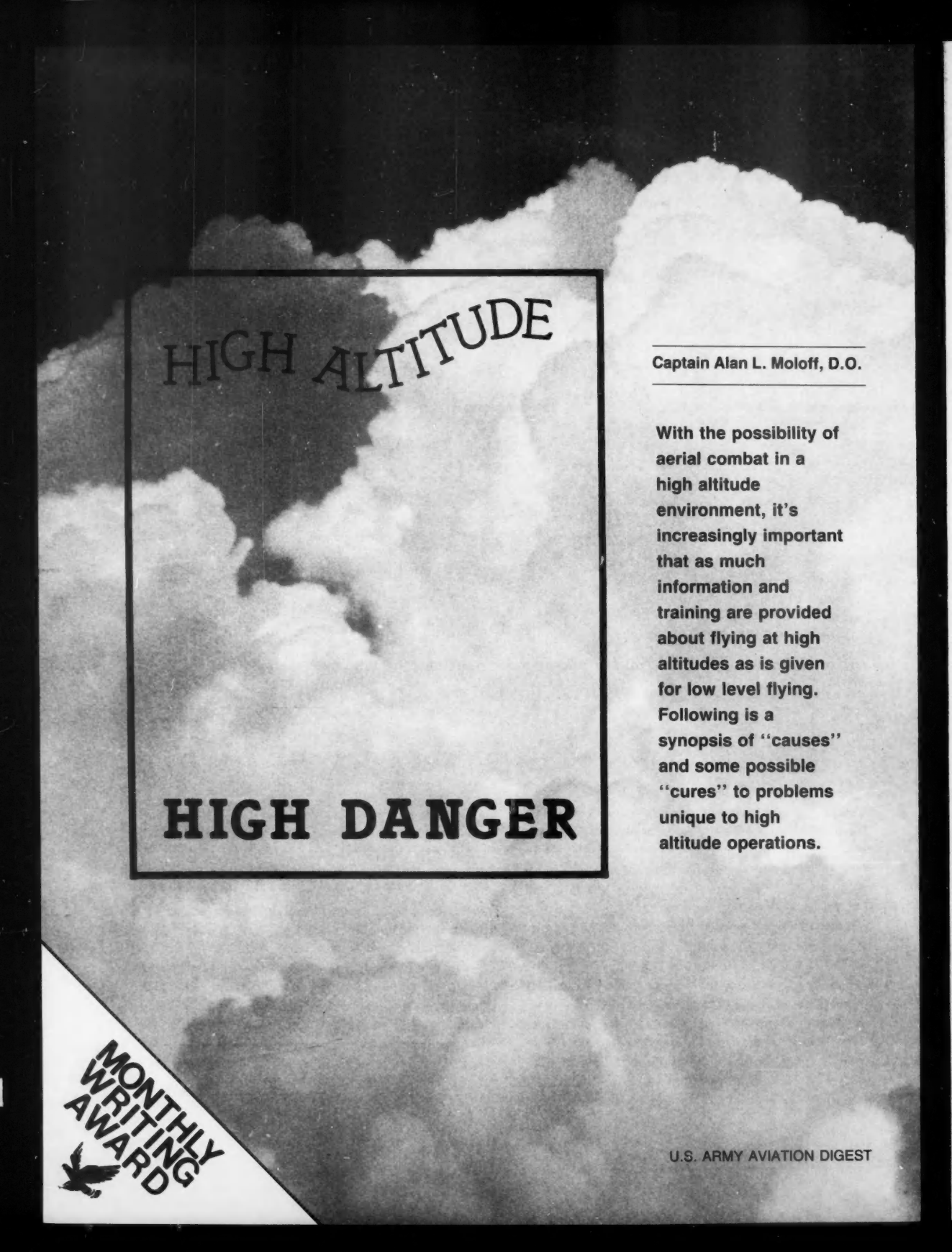
Forward Area Air Defense [FAAD] System



The equipment depicted is tentative and may not represent the final systems selected for FAAD.

primarily from a ground tactical operations center tent will continue to suffice for an aviation task force command and control system. It is increasingly obvious that without a modern, secure, automated C^3I system and real-time use of threat and friendly situation data, aviation forces will be limited to some very constrained AirLand Battle options, little if any better than our Grasshopper days' capabilities. Simply put, Army Aviation *must* field a modern C^3I capability to go along with its new force structure and weapons systems. This C^3I system also must be integrated into the Army's overall command and control system to permit data exchange within our functional areas.

Our dilemma in these days of reduced budgets, as the threat's checkbook allows the continued fielding of a wide variety of high quality weapon systems, is that we must remain ready to fight outnumbered and win. We want to generate high attrition rates for the threat and the lowest possible attrition rates for ourselves. The Army can win with a superior C^3I system and combined arms operations on the AirLand Battlefield. An integrated FAAD-aviation C^3I system can provide one solution to our combined arms success. Without it, the most advanced weapon systems or best trained operators or intentions in the world will be of little use unless they are fighting the right fight in the right place at the right time. Army Aviation and forward area air defense forces have a number of surprisingly common requirements and are in a unique position in time right now to share in a highly profitable, high gain joint venture.



HIGH ALTITUDE

Captain Alan L. Moloff, D.O.

With the possibility of aerial combat in a high altitude environment, it's increasingly important that as much information and training are provided about flying at high altitudes as is given for low level flying. Following is a synopsis of "causes" and some possible "cures" to problems unique to high altitude operations.

MONTHLY WRITING AWARD

THIS ARTICLE will review the principles and physiology related to high altitude operations. For the purpose of this article, high altitude will be defined as elevations in excess of 10,000 feet or 3,050 meters above sea level. At present, Army Aviation doctrine stresses low level flight and has deemphasized high altitude operations. However, 5 percent of the world's land mass is above 3,000 meters (9,850 feet). Our new helicopters such as the UH-60 Black Hawk and AH-64 Apache as well as the Army's fixed wing assets can and may be forced to operate in a high altitude environment. A familiarity with the physiologic implications of high altitude flying is essential for training, rapid deployment exercises and wartime operations. There are unique problems associated with low level mountain flying as well as problems associated with base operations and forward rearm/refuel points located above 6,000 feet.

"Our helicopters such as the UH-60 Black Hawk and AH-64 Apache as well as the Army's fixed wing assets can and may be forced to operate in a high altitude environment."

Physiologic responses to high altitude conditions vary with the rapidity in the change of elevation, duration of exposure and one's general physical condition. The body reacts differently to the stresses of a takeoff at sea level and a flight to 12,000 feet than it would to a 4-day hike to the same altitude. High altitude operations are unique from both a flight and base operations perspective due to the decreased partial pressure of oxygen, the decreased pressure of the atmosphere, decreased atmospheric moisture, greater intensity of sunlight and greater day/night temperature variation as compared to similar operations at sea level.

At sea level one standard atmosphere exerts a pressure sufficient to raise a column of mercury 29.92 inches or 760 mm at standard temperature and moisture content. This pressure drops to one-half at 5,500 meters (18,500 feet) and drops to one-fourth at 10,700 meters (33,000 feet). At 19,202 meters (63,000 feet) the atmospheric pressure is so low that blood will boil (change from a fluid to a gaseous state) spontaneously in the body. This phenomenon, of gases leaving a solution due to decreased pressure, is described by Henry's gas law.

The Earth's atmosphere is composed of about 21 percent oxygen and 79 percent nitrogen. This proportion remains constant at any altitude we would be flying in. Partial pressure is defined as the pressure exerted by each component of a gas mixture. As the altitude increases and the atmosphere "thins" out, the absolute concentration of oxygen becomes smaller and smaller. Therefore, at 5,500 meters the partial pressure of oxygen is about one-half of its partial pressure at sea level. For the purists, there are other factors that come into play such as moisture and actual barometric pressure so that this is an estimate.

Gas exchange in the lungs is an extremely efficient process. Outside air, high in oxygen, is drawn into the lungs during inspiration. Gas exchange between the blood and the inspired air occurs in the alveoli of the lungs. Carbon dioxide passively diffuses from the blood to the air while oxygen passively diffuses from the air to the blood. Ninety-nine percent of the oxygen in the blood is carried by the hemoglobin molecule inside the red blood cell. A small amount of oxygen and nitrogen is dissolved in the blood. Blood carries the oxygen throughout the body where it passively diffuses from the capillaries into the tissues.

Hypoxia is defined as the subnormal availability of oxygen for the tis-

AR 95-1 requires prebreathing 100 percent oxygen for flights above 18,000 feet for 30 minutes prior to take-off and en route to final altitude. This forces more oxygen and less nitrogen into the blood, thus decreasing the chances of nitrogen bubble formation.

sues. There is no specific altitude at which hypoxia begins due to variables such as work performed, acclimatization, general physical conditioning and rate of ascent. In general, symptoms of hypoxia begin around 10,000 feet. There are four stages of hypoxia based on presenting symptoms or complaints:

- *Indifferent Stage*: No observed impairment; however, scotopic vision (night vision, dark adaption) is decreased.
- *Compensatory Stage*: Physiologic mechanisms can compensate for the decrease in the partial pressure of oxygen. Muscular coordination and mental alertness do decrease. There is also an increase in fatigue and irritability and a decrease in judgment.
- *Disturbance Stage*: At this point physiologic mechanisms cannot compensate for the decreased partial pressure of oxygen. Visual acuity is severely diminished; there is a decrease in the extraoccular muscle coordination and a severe decrease in the peripheral vision. There are decreases in the ability of the mind to assimilate data, recall data and make proper judgments. Fine motor control (hands and fingers) decreases dramatically. These effects of hypoxia are routinely demonstrated during chamber rides. Remember, if it is difficult to write your name, it is impossible to fly safely.
- *Critical Stage*: There is almost complete physical and mental incapacitation leading to rapid loss of consciousness and death. This is a rare event but could occur during a sudden loss of cabin pressure or cessation of oxygen supply.

The other major problem of high altitude operations is due to the relative decrease in outside air pressure. Dysbarism is a syndrome resulting from the effect on the body, excluding hypoxia, of a pressure differential between surrounding atmospheric pressure and the pressure of gases within the body. Dysbarism can be divided between trapped gas and evolved gas syndromes.

The most common symptoms of trapped gas syndromes are ear, sinus or facial pain that occur more frequently during descent than ascent. The cause of this pain is due to the pressure differential between the outside air and air trapped within the middle ear (aerotitis media) and the sinuses (aerosinusitis). The process of equalization sometimes occurs naturally and sometimes needs to be helped along by the Valsalva maneuver (holding your nose while trying to blow air out of it). The eustachian tubes are a passageway from the middle ear to the back of the throat and are responsible for maintaining a pressure equilibrium between the middle ear and the outside pressure. When there is a sudden, rapid pressure equalization the ears "pop." This is due to the eardrum or tympanic membrane resuming its normal, nonstretched position. Clearing the ears or performing the Valsalva maneuver should be accomplished before pain begins. If this does not relieve the pain or pressure sensation the aircraft should resume its previous altitude. This is one of the reasons why aviators should not fly

when they have hay fever or upper respiratory infections; the clogged sinuses and eustachian tubes make it more difficult to equalize the pressure.

Other symptoms related to trapped gas dysbarism are barodontalgia and abdominal gas pain. Barodontalgia is characterized by mouth and jaw pain. This pain is due to air located between a tooth and dental filling material used to treat cavities. This air pocket, in a poorly treated cavity, expands as atmospheric pressure decreases causing pressure on the exposed nerves of the affected tooth. Abdominal gas pain is due to the expansion of the intestinal gases due to decreased outside air pressure. As we all know, there is a lot of gas in the intestine and some aviators have more gas than others. The only way to relieve this abdominal pain is to descend, thereby compressing the gas or by flatulence. Abdominal gas pain can be prevented or lessened by NOT eating high gas producing foods (beans, cabbage, etc.) 48 hours prior to a high altitude flight.

Evolved gas dysbarism is due to the evolution of nitrogen gas bubbles in the tissues and circulatory system. Nitrogen normally exists in a dissolved state in the blood stream and tissues. However, nitrogen will come out of solution and form bubbles during periods of lowered outside air pressure. These nitrogen bubbles physically block smaller blood vessels and mechanically traumatize cells of the body. This condition will be a rarity for Army aviators because it is an extremely rare occurrence below 23,000 feet. The incidence increases to 1 percent at 25,000 feet and 3 percent at 30,000 feet. These figures are for personnel in unpressurized aircraft. This disease is similar to decompression sickness that occurs in divers. I mention this for two reasons. The first is that it is the relative change in outside air pressure that determines the solubility of nitrogen in the blood. The second is that this is the reason that Army Regulation (AR) 40-8, paragraph 4-1, specifically prohibits flying or chamber exercises for 24 hours after diving.

AR 95-1 requires prebreathing with oxygen (100 percent, or not less than 90 percent on aircraft equipped with onboard oxygen generation systems) for flights above 18,000 feet for 30 minutes prior to takeoff and en route to final altitude. The breathing of 100 percent oxygen forces more oxygen and less nitrogen to be dissolved in the blood. Decreased amounts of dissolved nitrogen in the blood decrease the chances of nitrogen bubble formation.

There are four categories of evolved gas dysbarism. Each of these is named for the symptoms produced or the major organ system affected. The four categories are the *bends*, *chokes*, *creeps* and *neurocirculatory*.

The symptoms of the *bends* appear as muscle, bone and joint pain. The majority of the victims complain of joint pain. The pain is produced by the formation of nitrogen bubbles within the joint (mechanical trauma). Chest pain, difficulty breathing and coughing are characteristics of the *chokes*. The cough is initially intermittent but gradually progresses, if untreated, to a continuous and uncontrollable cough. The breathing difficulty (dyspnea) also gradually worsens without treatment. The *creeps* are cutaneous manifestations of the skin related to nitrogen bubble formation. The major symptoms are itchiness (pruritis) and a mottled diffuse rash.

The most serious and life threatening manifestations of evolved gas dysbarism are those of the *neurocirculatory* category. The initial symptoms are migraine-like headache pain and visual disturbances. Intermittent blind spots (scotoma) are the primary visual disturbances. Nitrogen bubbles may also form around the spinal cord leading to paralysis, primarily paraplegia. The neurocirculatory manifestations may progress to increased heart rate (tachycardia), convulsions and loss of consciousness.

There are some predisposing factors that are related to evolved gas dysbarism. Older aviators, aviators in poor physical conditions and those with excess body fat are at greater risk for this syndrome. Excessive exercise and cold temperatures at altitude also increase an individual's risk factors.

If any of the symptoms of evolved gas syndrome appear it is important to descend immediately. Administer oxygen to the affected individual as soon as possible in the highest concentration available. A landing should be made at a facility that has a hospital and dive chamber. Hospitalization is mandatory for any person that has experienced neurocirculatory symptoms. I recommend a 24-hour observation period for any person that has experienced any symptoms of evolved gas dysbarism. AR 40-8 requires grounding of any aviator that has experienced symptoms of evolved gas dysbarism until examined by a flight surgeon.

Decreased moisture at high altitudes makes insidious dehydration for aviators and support personnel a serious problem. Perspiration evaporates rapidly and there is a greater fluid loss during breathing. The individual does not realize just how dehydrated he has become while functioning at high altitude. Thirst comes into play at 2 to 3 percent dehydration but is not a good indicator of dehydration because one tends to

underdrink and remain less than properly hydrated. Normal urination (every 2 to 3 hours) is a good indicator of proper hydration. Commanders must ensure that personnel drink fluids on a predetermined schedule whether the individual is thirsty or not. Urine that is dark yellow or brown indicates that an individual is dehydrated and must increase fluid consumption.

The higher the altitude the greater the amount of ultraviolet light there is available to cause sunburn. This is because there is less atmosphere to filter out these harmful rays. This could lead to serious sunburns on numerous individuals due to exposure during duty or free time. Supervisors at all levels must ensure that individuals are properly clothed (hats, long sleeves, sunglasses) and use sunblockers liberally and frequently. Sunblockers and sunglasses are available through the Army supply system.

There is a greater day/night temperature difference at high altitudes than at sea level. It is therefore necessary to assume that every night will be a cold night. All aircraft should carry enough survival equipment so that a crew could survive more than one night in subfreezing temperatures. Predeployment planning should seriously consider the effect of daily temperature extremes on the mission, maintenance of equipment and human capabilities.

AR 95-1, C6, paragraph 2-15, clearly delineates requirements for safe flying at specific high altitudes. I recommend that you review this regulation in conjunction with this article.

The references listed at right are an excellent source for a more indepth discussion of the factors that I have reviewed. Your local flight surgeon can also answer any questions you may have.

"All aircraft should carry enough survival equipment so that a crew could survive more than one night in subfreezing temperatures."

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ABOUT THE AUTHOR

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U.S. ARMY SAFETY CENTER

EXPECTATIONS

CW4 Robert J. Rendzio

The views expressed in this article are those of the author and are not necessarily those of the Department of the Army or the U.S. Army Safety Center.

In the next four issues of the U.S. Army Aviation Digest, *the author addresses a problem Army aviators must always remain conscious of—detection and avoidance of wires. He explores some of the limitations, in people and equipment, that impact on this particular hazard to safe flying.*

The scenario of the first article involves a highly experienced instructor pilot and an equally inexperienced copilot. This flight should have been uneventful—the kind of training flight that takes place every day throughout the Army. But when the routine flight suddenly goes IMC, the first link is forged in a chain of events that can lead to an accident. The question is asked, "Do we, and aviators themselves, sometimes expect too much, regardless of how capable and experienced pilots may be?"

In the second article, "Human Frailty," another aspect of human limitations will be discussed—what the human eye is capable of seeing and how what we see is interpreted by our minds. These limitations have a definite effect on an aviator's ability to detect and avoid wires.

The third article is about wire strike protection systems (wire cutters). The author gives us his opinion on how much we can reasonably expect from the systems currently in use and whether there is something better in the future.

The fourth and final article deals with wire detectors. These wire detectors, together with the wire cutters already in use on many Army aircraft, might provide the answer to the losses the Army is still experiencing from wire strikes.

PILOT J. DOE has been in Korea for nearly 6 months. He arrived in the aviation unit with his arm in a sling and, because of medical complications, things haven't gone well. He's been moved into new jobs twice by the command so they could get some use out of him; first as a supply officer and then as an executive officer.

About 3 months ago, he took a currency flight in an OH-58 Kiowa, but that is about all the recent flying he's done because of his job. Today that's going to change. He's going to fly, only this flight and future flights will be in an AH-1 Cobra.

Doe was rated in the AH-1 right after flight school and while that was 6 months ago, he still feels confident. After all, his instructor pilot (IP) today is one of the best; he should be able to bring Doe up to speed with no problem. To top it off, this will be a day/night mission, so he'll get some good training.

Crew Background

Let's take a look at this crew. First, we have a highly experienced IP. He has more than 1,500 hours as an IP in the AH-1. He's a careful pilot, and he's also familiar with the hazards of flying in Korea, especially that nemesis of all aviators, wires.

We already know that we have a copilot who's hardly more than a rated student. He has to muster all he has just to fly proficiently; and, because of a medical grounding, he has flown only 12 hours in the previous 6 months.

This, then, is the crew. We have saddled an IP, on whom all our hopes are pinned, with a burden that, un-

fortunately, isn't all that unusual. Before this flight is over, he will fall victim to "task creep"; that is, an accumulation of many minor tasks and responsibilities that individually are insignificant, but collectively can destroy a mission: the copilot's lack of complementary ability, a mission that is unrealistic considering the joint proficiency of the crew, and marginal weather conditions.

One or two of these conditions would not be an insurmountable obstacle for such an experienced IP; but when so many negative factors are stacked, the cumulative effect can degrade the crew's overall ability to perform.

Expectations . . .

Why would a flight like this ever be approved in the first place, and why would an experienced IP accept such a mission? It may be because the process that leads to an accident is oftentimes insidious. When we look back at the chain of events leading up to an accident, it may seem clear that several people had the opportunity to break the chain and prevent the accident. But at the time, everyone was simply doing what they thought they were supposed to do and what seemed best.

Generally, we rely heavily on IPs to police themselves but, because they are human, they are susceptible to the same kinds of pressures we all face. IPs aren't somehow magically excluded from money problems, a wife who's never home, a friend who comes over entirely too much or kids with problems at school. Nor is an IP exempt from job stress: getting stuck with a job he doesn't like, boredom and overwork. And IPs are just as susceptible to physical ailments as anybody else, whether it's the common cold or something much more serious. In other words, the things that plague the rest of us aviators are things an IP has to cope with too. IPs aren't that different—except in one of those areas mentioned. When it comes to overwork, they're probably worse off than the rest of us.

Most aviators look at IPs as a cut above the rest. They've earned that position through a high degree of professionalism and fortitude. We go to them for guidance on key aviation issues and when, for instance, we're given a really tough night mission under marginal conditions, it's the IP we go to for help. Why? Because he usually has the answers, and "because he can do it."

Can be over Expectations . . .

So the IP gets the tough jobs, and if by chance he falls short, we're puzzled as to why. We sure didn't fail him, did we? All we wanted from him, after all, was a simple day/night VFR (visual flight rules) tactical mission during weather where ceilings were forecast at 500 feet. Incidentally, those ceilings will probably turn out to be more like 200 to 300 feet at the very best, but it's time enough to talk about that when the mission is completed. As the ceilings close down, you can just about bet the visibility won't be too good either, but, again, we can talk about that when the mission is over.

Sometimes the IP and his charges don't come back from the mission and we're mystified. After all, he was an IP, wasn't he?

So, all we want the IP to do is take Pilot J. Doe, who hasn't flown more than 12 hours in 6 months, and give him some good day/night training. Of course we asked the IP if that was OK with him. After all, we wanted him to be part of this decision process. But what do you think he hears us really asking him? "Are you capable of doing this job? Are you really good enough? Can you handle the weather?" That's what he hears and, remember, he's a lot like us. What would we say?

As a matter of fact, the IP may be completely right in his interpretation of the question. We may be sincere in asking it, but it's a challenge nonetheless. Now, although he may teeter on the brink of refusal the IP can, in his own estimation, do what we are asking him to do, so he accepts.

The IP also senses that he is needed. Doe needs the flight time and he needs the IP's help to get fully qualified. Then there's the commander. He wants to get Doe

current in the aircraft just as soon as possible because he's short of pilots. The IP thinks the commander is a decent guy, and his perception of how the commander views him also figures into the IP's decision.

These are powerful motives for taking on a mission: confidence, the desire to help someone, a bit of old-fashioned unit esprit and the IP's self-image. The IP makes the human choice; he says "Yes."

A casual, disinterested observer given all the negative factors in this mission would probably say "No." But there were no disinterested observers. The commander had an aviator who needed to be trained so that he could pull his own weight in the unit. The IP had a stake in seeing that the unit's mission was accomplished. The copilot needed the training. None of them was going to object to the mission. But there was one other person who should've been involved.

Why didn't the safety officer object?

This unit's safety officer was more interested in his rating scheme than in the welfare of his colleagues. After all, "his files were straight."

. . . and the mission may be destined for failure.

So the IP set out on the mission, and once he was off the ground he would find that he was the only member of the crew who was viable under stress. When the aircraft went IMC (instrument meteorological conditions) the inexperienced, uncurrent copilot was scared to death; the job of salvaging the aircraft went to the IP. When he realized the situation he was in, the IP was scared himself. His mind went back to his last close call, and that time he was with a pilot who had 15 years in aviation and 3,000 hours of flight time! This time he's on his own; his copilot isn't going to be much help.

How does it turn out? Does task overload get so bad the IP is flying behind the aircraft? Does the low ceiling and poor visibility cause him to drop down and hit one of those wires that have been in the back of his mind? The way it ends doesn't really matter that much. The thing is, if the IP is able to get out of this situation, his common sense may be diluted in the future by his success in "pulling it off." If he fails, will he be condemned for not being able to do his job as an IP? We say "No," but history has shown otherwise.

So what actually happens is the IP has been placed in a no-win situation. Needless to say, if the flight fails, the fate of the IP and his copilot has been sealed. However, if the flight succeeds, then the attitudes and perceptions of all those involved may be negatively reinforced. You can be assured that when the IP is asked again about a mission like this one he'll look back to this day. The real question is, ***will we***?

ABOUT THE AUTHOR

CW4 Robert J. Rendzio is a safety officer assigned to the 3d MI Battalion in Korea. He has been involved with aviation safety for more than 10 years, serving in that capacity at various levels within the Army. Key assignments include the 7/1 Cavalry at Ft. Knox, KY; the 235th Attack Helicopter Company in Germany; the 6th Cavalry Brigade at Ft. Hood, TX; and the U.S. Army Safety Center at Ft. Rucker, AL.

CW4 Rendzio is a graduate of Embry Riddle Aeronautical University where he majored in safety. A frequent contributor to *Flightfax* and *Countermeasure*, CW4 Rendzio is also the author of a widely distributed pamphlet, "Fire Extinguishers: Principles and Operations and a Treatise on Extinguishing Agents." He is an authority on fire detection systems, a subject in which he has particular interest.

Touchdown Emergency Procedure Evaluation

ALL OF YOU Army rotary wing aviators are, no doubt, aware of the prevailing restrictions on touchdown emergency procedure training. Unless you've had a recent local transition, have been to an Army training base for schooling or have had an actual emergency, you haven't been authorized to perform these maneuvers (with the exception of hovering autorotations) in more than 3 years.

The Department of the Army imposed the prohibition on touchdown emergency procedure training in April 1983. The action was taken in response to the high costs and safety risks associated with practicing the maneuvers. The prohibition has since been labeled the moratorium on touchdown emergency procedures or "the moratorium," for short. Not long after the moratorium was imposed, concern began to develop over its long-term effects.

For the last 2 years, the Technical Support Branch of Directorate of Evaluation/Standardization (DES) has been evaluating the moratorium's impact. Our most recent study addressed flight performance, logistical and safety data relating to UH-1 Huey, OH-58 Kiowa and AH-1 Cobra aviators. What follows is a recap of the major evaluation findings prepared for the 1986 U.S. Army Aviation Commanders' Conference.

Aviator Performance

Aviator performance on touchdown emergency procedures is weak. Given that the tasks are not practiced, any other finding would have been a surprise. The majority of the aviators who were checked on these maneuvers required either verbal or physical assistance to successfully complete the tasks.

Tasks in which evaluators had to provide verbal assistance to the majority of the aviators sampled were:

- Hydraulic system malfunction.
- Standard autorotation.
- Low level autorotation.
- Low level/low airspeed autorotation.

Tasks for which most aviators in the sample required physical assistance from the evaluators were:

- Low level/high speed autorotation.
- Antitorque malfunctions.
- Autorotation with 180-degree turn.

Although the data indicate that performance is weak, it is important to point out that our analyses found no decline in performance from 1985 to 1986. At this juncture, the data suggest that we have reached a level of performance on the tasks that can be maintained without actually practicing the maneuvers to the ground.

Logistical Data

The Army Aviation Systems Command provided data concerning the repair or replacement of subsystems that subject matter experts considered most likely to suffer from the performance of the prohibited maneuvers. The data confirmed our expectations. The related components are not being repaired or replaced as often since the imposition of the moratorium.

Safety Data

The Army Safety Center provided data concerning accidents that involved the prohibited tasks. Due to the few accidents involving hydraulic and antitorque malfunctions, autorotation accidents were the focus for our analyses.

Practice autorotations. These accidents are directly related to practicing the emergency procedures. By their nature, pilot error is implied as the main cause of the accident. Accidents in this category show a marked decline in frequency since 1983 as well as a $6.7 million savings in aircraft damage costs and a $1/2 million savings in injury costs. These savings can be directly attributed to the moratorium imposed on the training of the maneuvers.

Emergency autorotations. These are accidents related to actual emergencies that are not purposely initiated by the pilot. Since 1983 there has been a slight decrease in the frequency of accidents in this mishap category while at the same time an increase of $2.8 million in aircraft damage costs and a $1/2 million increase in injury cost. These data suggest the start of a trend in which the cost per accident is rising. At this point in time, however, there is not enough data accumulated to support or refute such a contention. Other factors such as inflation and the involvement of high tech and, therefore, high dollar equipment could be involved. Whatever the basis might be for these data, it is most important to keep in mind that the costs represented here are still overshadowed by a substantial decline in training accidents and damage costs because of the moratorium.

Conclusions

Several million dollars have been saved through reductions in training related accidents and aircraft maintenance costs. Although aviator performance on the prohibited tasks is low, we have good indications that it has stabilized. Logistical data show the benefits of the moratorium in increased time between parts replacement. No significant statistical trends are evident from the analyses of flight safety data. Overall safety and logistical figures presently reflect an improved system, in spite of the weak performance that was found on the tasks. Taken on the whole, the evidence overwhelmingly supports the continuation of the moratorium.

Footnote

As was mentioned earlier, our evaluation was inspired by concern over the long-term effects of the moratorium. The 2-year effort that underlies this article is just the beginning of a look into those long-term effects. The DES will continue to be involved in evaluations of the moratorium's impact. We want to ensure that it remains as much an asset in the future as it is now.

DES welcomes your inquiries and requests to focus attention on an area of major importance. Write to us at: Commander, U.S. Army Aviation Center, ATTN: ATZQ-ES, Ft. Rucker, AL 36362-5000; or call us at AUTOVON 558-3504 or Commercial 205-255-3504. After duty hours call Ft. Rucker Hotline, AUTOVON 558-6487 or Commercial 205-255-6487 and leave a message.

U.S. Army Class A Aviation Flight Mishaps

	Number	Flying Hours	Rate	Fatalities	Total Cost (in millions)
FY 86 (through 30 September)	34	1,669,276	2.04	27	$73.0
FY 87 (through 30 September)	38	1,695,434*	2.24*	42	$92.6*

*estimated

PEARL'S

Personal Equipment And Rescue/survival Lowdown

Oxygen Masks

Caution should be exercised while wearing oxygen masks in the aircraft. A recent preliminary report of an aircraft mishap revealed the pilot discovered that his oxygen mask mike cord was stuck in the side hatch securing mechanism where the hook engages the eyelet. In an attempt to free the mike cord the side entrance hatch was inadvertently released, allowing the hatch to open. Aircraft landed without further damage.

AR 95-17, ALSE

Implementation of paragraph 2-9b has again been delayed due to shortages of the PRC-90 survival radio per DALO-AV Message 122010Z May 87. In the interim, the pilot in command (PIC) will continue to ensure that not less than one fully operational survival radio is onboard the aircraft. This does not preclude other aircrewmembers from carrying additional radios onboard the aircraft when assets are available. Furthermore, the PIC will ensure that aircrewmembers without radios have other required signaling devices; e.g., L119 foliage penetration flare signal kit and the signaling mirror. HQDA point of contact (POC) is Major Hinds, DALO-AV, AUTOVON 227-0487.

Notice To All Army Pilots

The U.S. Department of Transportation, Federal Aviation Administration, has asked us to help them and has published the following notice:

- All emergency locator transmitter (ELT) transmissions are now reported to search and rescue by satellites.
- Ninety-seven percent of ELT reports can end up being false alarms—more than 600 per month.
- Search for false alarms detracts from the search for a downed aircraft—that aircraft may be yours.
- Before you startup and after you shutdown, tune your aircraft receiver to 121.5—your ELT may be transmitting.
- If your ELT was on—call your flight service station as soon as possible.
- Check your ELT batteries—dead batteries will not send a distress signal. NOTE: *Never ship or store the ELT with the battery installed.*
- An operable ELT may save your life.
- Disconnect the ELT battery whenever you remove an ELT from an aircraft.

SPH-4 Helmet Retention Assembly

The extra large retention assembly, national stock number (NSN) 8415-01-056-0699, is no longer procurable. The correct replacement is the regular retention assembly, NSN 8415-01-056-0700. This assembly is now considered a one size fits all for both sizes of the SPH-4 helmet.

POC For ALSE and Aeromedical Issues

LTC Howard McClelland, MS, joined the HQ AMC (AMCRE-AV) staff at Alexandria, VA, on 1 June 1987 and is the HQ AMC point of contact for aviation life support equipment (ALSE) and aeromedical issues. LTC McClelland is interested in and soliciting your comments concerning ALSE or aeromedical issues affecting your operation. Call AUTOVON 284-9891/2 or write HQ AMC, ATTN: AMCRE-AV, 5001 Eisenhower Avenue, Alexandria, VA 22333-0001. The AMC Product Manager for Aviation Life Support Equipment

(AMCPM-ALSE-L) would appreciate receiving a copy of your comments in order to expedite resolution of immediate ALSE problems, as they pertain to ALSE logistics/readiness.

Water Survival Training

The purpose of water survival training is to instill in all aviation personnel a continuing awareness of the hazards of the water environment and to familiarize them with ALSE and all procedures used to ensure their survival.

ALSE Questions and Answers

What is the status of the ALSE supervisor course, and has the course been approved to meet the requirement of paragraph 3-2, AR 95-17?

Letter, U.S. Army Aviation Logistics School, ATSQ-TDI, dated 27 March 1987, subject as above, approved the course to meet the requirement of paragraph 3-2, AR 95-17. Personnel who have been awarded an additional skill identifier of 1F or Q2 are authorized to perform inspections, tests, repairs and other maintenance on all ALSE. POC is Mr. Boone Hopkins, AUTOVON 693-3215/3817.

The Army Western Region Aviation Survival School, Vancouver, WA 98661-3826, has good information on use of parachute survival (suspension cord). Can you provide us some "tips"?

Whenever possible, carry at least 50 feet of parachute suspension line in your survival kit/vest, or cut the line in pieces and stow in several pockets. Melt the ends to keep from fraying, but use caution—melted lines can cause burns comparable to hot tar or lead. Camouflage white line by rubbing in dirt, mud, sand or charcoal; do not waste suspension line, every inch could become important in a survival situation. Do not discard scraps of line in the bush—telltale signs remain for a long time. Use for thread when taken apart, use candle wax—can be threaded for sewing. Make a rope by twisting suspension lines together; suspension lines can be used for shelter construction, animal snares, weaving snowshoe webbing and harnesses, rigging, making a gill net and 101 lashing and tying uses. A heavy duty rope can be made by twisting two lines together with an approximate tensile strength of 1,150 pounds.

New Survival Kit Components

TM 55-1680-317-23&P, "Organizational and DS Maintenance Manual for Army Aircraft Survival Kits," has undergone major revision and was fielded in March 1987. The following new survival components are added to survival kit, individual, hot climate, NSN 1680-00-973-1861:

- Survival kit, individual, cold climate, NSN 1680-00-973-1862
- Survival kit, individual, overwater, NSN 1680-00-973-1863
- Match, aviation survival, nonsafety, NSN 9920-01-154-7199
- Knife sharpener, general purpose, NSN (not yet available)
- Fire starter, aviation survival, NSN 1680-01-160-5618
- Saw, hand, finger grip, NSN 5110-00-570-6896 is being added to survival kits, NSN 1680-00-973-1861 and NSN 1680-00-973-1862.

Some of the existing survival kit components have been repackaged, which has increased their size and caused the rearrangement of the inner cases of the aforementioned survival kits. The matches, knife sharpener, fire starter and finger grip saw will be packed in the inner case of the survival kits. If closing problems arise from the addition of these components, remove as many cans of survival rations as required (do not exceed three cans). Pack the removed cans in the survival kit outside pocket with the operators manual.

Point of contact for this action is Mr. Boone Hopkins, AMCPM-ALSE, AUTOVON 693-3215/3817 or Commercial 314-263-3215/3817.

If you have a question about personal equipment or rescue/survival gear, write PEARL'S, AMC Product Management Office, ATTN: AMCPM-ALSE, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798 or call AUTOVON 693-3817 or Commercial 314-263-3817.

Mr. S. A. Austin
Mr. John A. Moore

AH-64

A TOTAL SYSTEM FOR BATTLE

This fifth article in the Apache series describes the flight and cyclic controls, rotor and drive systems. Information provided is intended for familiarization; it must not be referenced for AH-64A aircraft operation or maintenance.

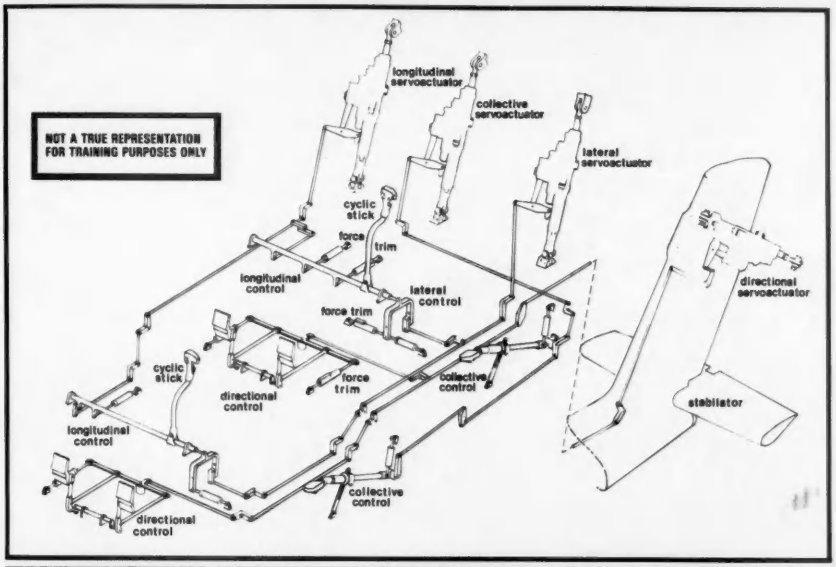

FIGURE 1: Flight control system.

Flight Control System

The AH-64A's primary flight control system (figure 1) provides the flight crew with the means to transmit collective, lateral and longitudinal cyclic and directional control movements, via mechanical linkages and hydraulic servoactuators, to the rotor system. An electrically controlled stabilator gives additional stability and control around the pitch axis of the aircraft.

Components of the mechanical flight control system are ballistically tolerant except where redundancy provides other means of control.

Collective controls provide a means for mechanical command inputs for vertical control of the helicopter, and they also provide mechanical inputs to the load demand spindles for automatic governing of each engine's speed.

Up and down movement of the collective is derived from the housing assemblies installed to the floor and the bulkhead at the rear of each crew station. Both housings contain shear pin actuated decouplers (SPADs) and linear variable differential transformer/transducers for input to the digital automatic stabilization equipment (DASE) computer.

Two control rods with a bellcrank connect the copilot gunner's collective controls to the pilot's collective controls. From the pilot's station aft, a series of control rods and bellcranks route control input to the collective servoactuator.

A 1G (gravity) spring, attached to the collective stick and the fuselage, offsets the weight of the stick when hydraulic power is applied to the collective servoactuator.

Each collective stick (figure 2, page 20) has a twist-grip, a rotary friction adjustment and an engine chop collar located between the stick grip and the switch box that permits simultaneous reduction of both engines to IDLE speed. There is a backup control system *engage trigger* on the underside of each collective stick; however, only the copilot gunner's is operational.

A stabilator manual control and an automatic operation/audio tone reset switch mounted on the right of the stick allows either crewmember to manually control the position of the stabilator, and to reset the automatic operation and audio tone.

A switch box on each collective stick houses controls for the searchlight, the emergency stores jettison, the searchlight extend/retract and directional control switch. The box also provides switches for radio frequency override (not operational), night vision system and boresight helmet mounted display/polarity switch.

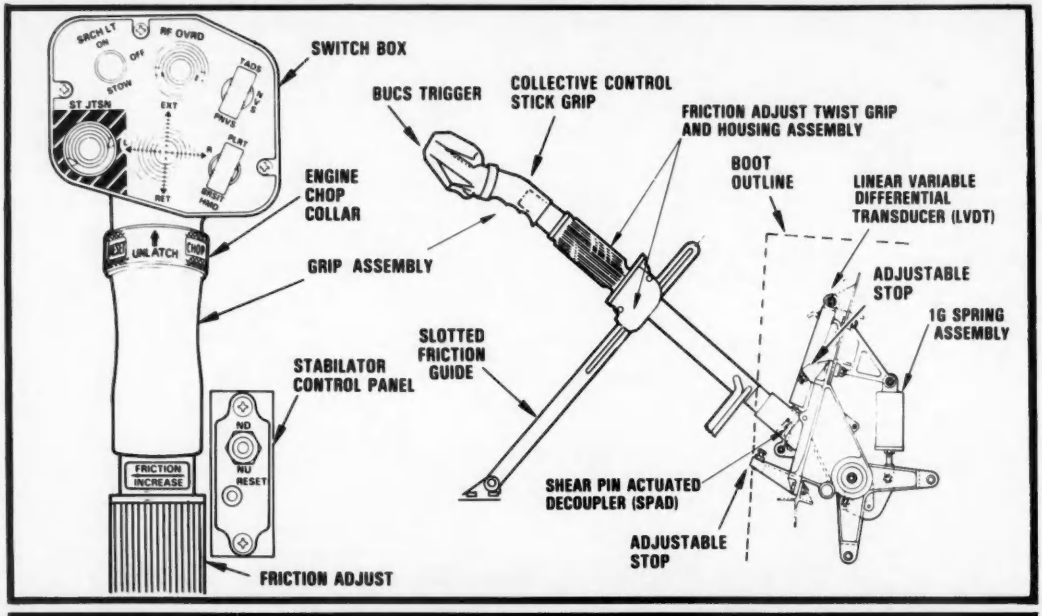

FIGURE 2: Collective stick and switch box.

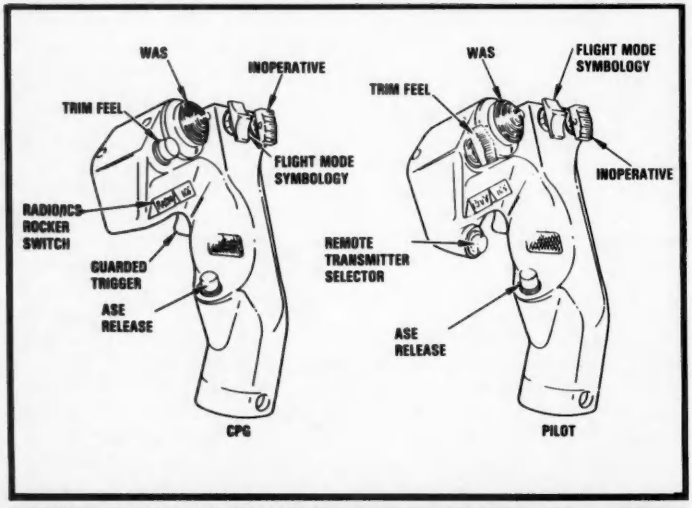

FIGURE 3: Cyclic stick grips.

Cyclic Controls

Cyclic control provides mechanical command inputs for the pitch and roll axes of the helicopter.

Longitudinal control motion is transmitted from the stick through the yoke and torque tube, to the longitudinal control linkage. Adjustable longitudinal and lateral stops prevent overtravel of the cyclic controls in any direction.

Lateral cyclic stick linkage is routed along the left side of the forward fuselage section whereas longitudinal linkage is routed along the right side, each to its respective hydraulic servos.

The copilot gunner's and pilot's cyclic controls are connected by a series of control rods and bellcranks. Linkages at both crewstations incorporate longitudinal and lateral SPADs.

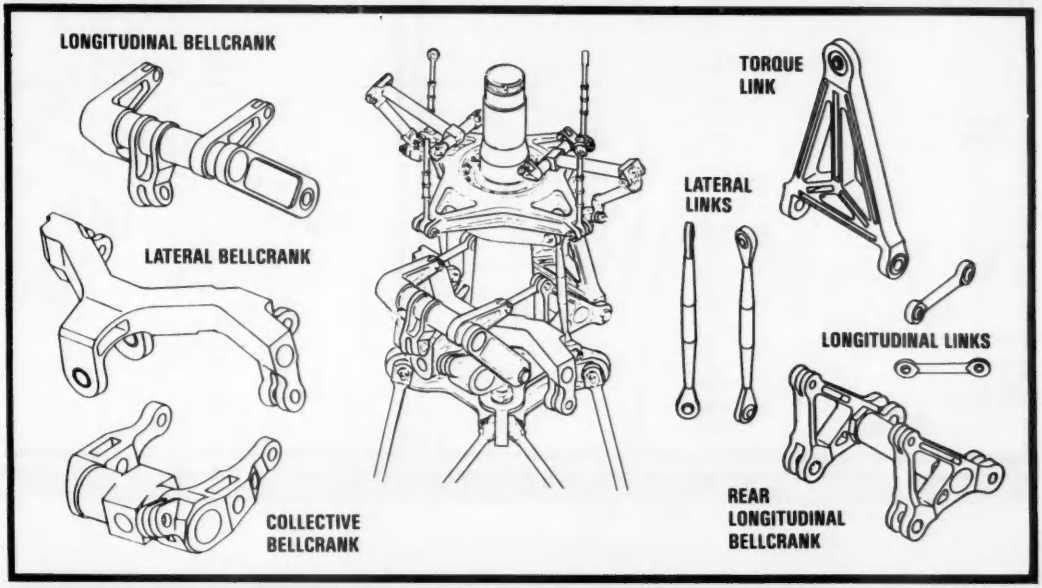

FIGURE 4: Mixer assembly.

Linear variable differential transformer/transducers, connected to both cyclic sticks, provide inputs to the DASE computer. These inputs are used for pitch and roll stability augmentation system and command augmentation system solutions, and for back-up control system control.

To allow a greater degree of maneuverability in the operation and use of the optical relay tube as well as for ease of ingress/egress, the copilot gunner's cyclic stick can be manually folded downward and locked; the copilot can still control the aircraft with the stick in the folded position.

Both cyclic stick grips (figure 3) incorporate switches for radio/ICS common trim feel and ASE release; a guarded trigger; and switches for weapon activation, and flight mode symbology. The pilot's cyclic stick grip also has a remote transmitter selector switch.

The mixer assembly (figure 4) mounted around the stationary mast intermixes control inputs from the collective, lateral and longitudinal servoactuators, and transmits them to the stationary swashplate mixer. A *torque* link that connects the mixer to the stationary swashplate provides longitudinal control and prevents rotation of the swashplate. Two *lateral* control links connecting the mixer to the swashplate provide lateral control. Both longitudinal and lateral links provide control to the stationary swashplate.

The swashplate assembly (figure 5) consists of a rotating and a stationary swashplate. A large Teflon spherical slider bearing permits the swashplate to tilt in any direction for cyclic control. For collective control, the bearing permits vertical control motion by sliding over a hardened surface on the stationary mast.

Two opposed scissors assemblies connected to horns on the rotating swashplates and the bottom of the main rotor hub cause the rotating swashplate to turn with the hub.

Four adjustable pitch links, connected to the rotating swashplate and horns on each pitch housing, transmit control motion to the main rotor blades.

The directional control system provides a means for control of the aircraft around the yaw axis. The copilot gunner's control pedals are connected to the pilot's pedals. Control linkage is then routed aft on the left side, then toward the helicopter centerline, to the directional servo-

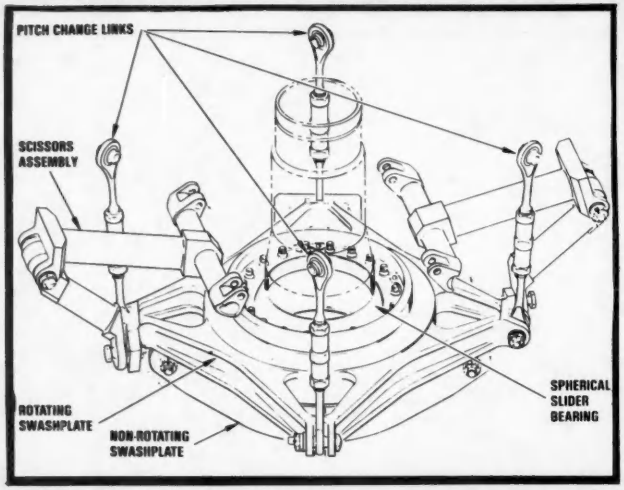

FIGURE 5: Swashplate assembly.

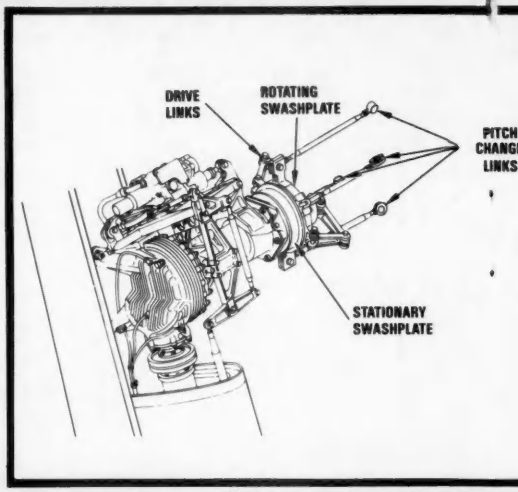

FIGURE 6: Tail rotor pitch controls.

actuator that is mounted on the tail rotor gearbox.

The pedals can be adjusted longitudinally by a pedal adjust quick-release lever; moving the lever to the right to UNLOCK, setting the pedal position, then releasing the lever. The upper portion of each pedal is used to apply the main landing gear brakes.

In order to transmit control motion input to the tail rotor blades, a swashplate assembly (figure 6) is used in much the same manner as in the main rotor swashplate assembly. Two opposed drive links, connected to horns on the rotating swashplate and the bottom of the fork assembly, cause the rotating swashplate to be driven with the tail rotor. Four non-adjustable pitch links, connected to the rotating swashplate and horns on each pitch housing, transmit control motion to the tail rotor blades.

The trim operation of the flight controls reduces the pilot's workload by maintaining a constant cyclic stick and directional pedal position.

Trim controls (TRIM REL) are installed in the pilot's and copilot gunner's cyclic grips.

Pressing the copilot gunner's TRIM REL button or pushing the pilot's TRIM REL switch forward releases a magnetic brake and spring assembly and allows the springs to travel until they are moved to the new control positions. Releasing the button or switch allows the magnetic brake to reengage and hold the springs at that position.

Should the pilot position his TRIM REL switch to the full down position, the trim operation will disable entirely (OFF).

A stabilator is attached to the lower aft side of the vertical stabilizer. The stabilator improves the aircraft's handling characteristics and permits increased forward visibility.

In the manual mode (or if the auto mode has failed), these pitch changes range from +35 to −10 degrees as measured against the leading edge. In the automatic mode, the change of the angle of incidence is reduced to +25 degrees and to −5 degrees.

A stabilator position indicator is located in each crewmember's station, in the upper right-hand portion of the respective instrument panels.

The indicator shows the position of the stabilator in 5-degree increments. When there is no power to the stabilator control system (SCS), an OFF flag will appear at the lower portion of the scale and the indicator needle will become masked. The placard displays the airspeeds not to be exceeded for any given angle of incidence on the stabilator.

A manual stabilator (MAN STAB) light on each crewmember's caution/warning panel, indicates if the automatic portion of the SCS has failed or if the manual mode has been selected.

An audio tone in each crewmember's headset also warns them if an SCS automatic mode failure occurs.

Pressing the STAB AUTO ac and dc circuit breakers in permits the au-

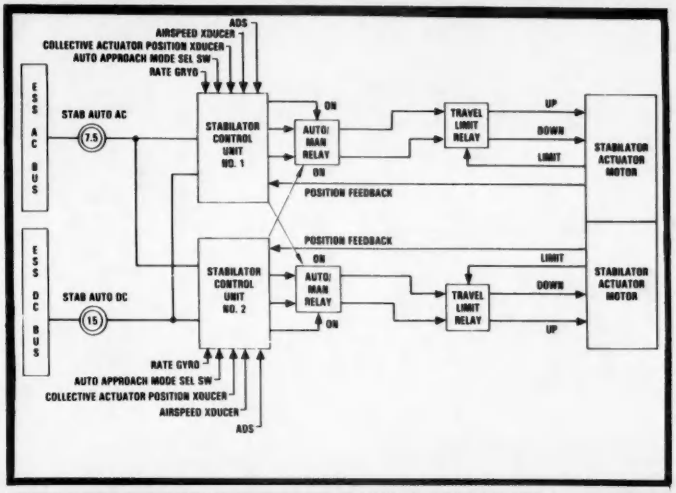

FIGURE 7: Stabilator automatic operation.

tomatic operation (figure 7) of the SCS. The SCS will automatically conduct a self-test and, if the circuit logic is correct, the stabilator control units (SCUs) will activate the automatic function at or above 30 knots forward airspeed.

The dual SCUs process input from five sources:

- auto approach mode select switch (NOE/APRCH)
- collective actuator position transducers
- airspeed transducers
- air data sensor (ADS) system
- rate gyros.

This processing results in a scheduled signal (generated by the dual SCUs) to the dual stabilator actuator motors that react by extending or retracting the stabilator actuators according to the signals.

The purpose of the auto mode of the stabilator is to reduce the pilot's workload. It will position the stabilator automatically during all airspeeds of more than 30 knots. At airspeeds less than 30 knots, the stabilator positions to 25 degrees trailing edge down (TED). In the nap-of-the earth/approach (NOE/APRCH) mode the stabilator provides better visibility for the crewmembers during NOE flight or when better forward visibility is required, such as on an approach.

The pilot must place the NOE/APRCH switch, located on the pilot's ASE panel, to the NOE/APRCH position. This will cause the stabilator to remain at 25 degrees TED at all airspeeds up to 80 knots. More than 80 knots, the stabilator begins to position according to the automatic processing schedule.

The NOE/APRCH switch remains magnetically latched at airspeeds higher than 80 knots; when the aircraft transitions back through 80 knots, the stabilator again returns to 25 degrees TED.

There are two main purposes for the stabilator manual mode: to provide crewmembers a means of controlling the stabilator if the auto mode should fail; and, to provide crewmembers more controllability and permit better visibility when required by conditions at airspeeds slower than 80 knots.

At airspeeds below 80 knots true airspeed (KTAS), the manual mode is selected by pressing the manual control switch either forward (nose down) or aft (nose up). Selection of the manual mode will cause the pilot's and copilot gunner's MAN STAB light to come on. Once the stabilator has been moved manually, the auto mode is disengaged. Regaining the auto mode after manual mode has been selected can be accomplished by pressing the automatic operation/audio reset button or airspeed transition above 80 KTAS.

If the stabilator actuator becomes fully extended or retracted, a limit switch is activated and electric power to the respective side of the actuator motors is deenergized. Motoring the actuator in the opposite direction opens the limit switch, and again allows operation in either direction.

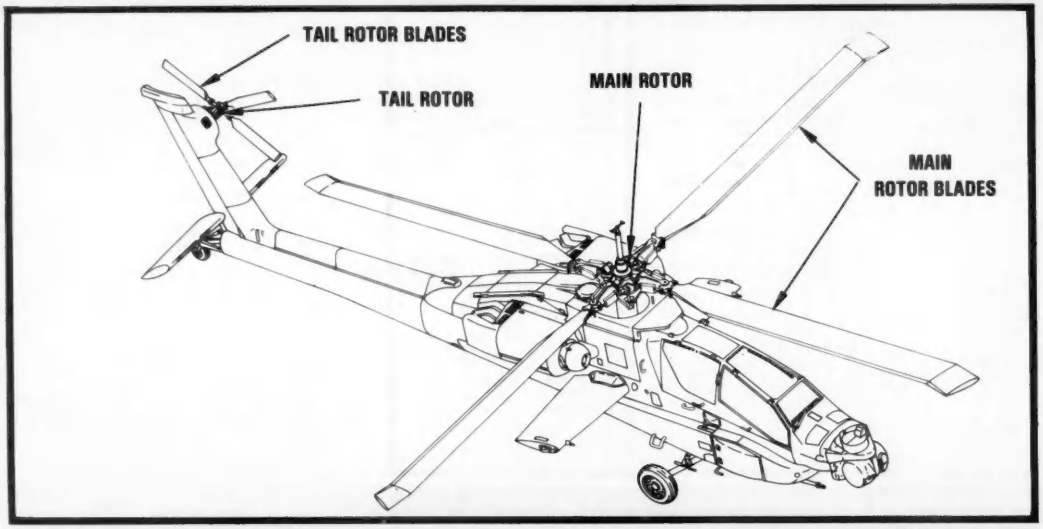

FIGURE 8: Rotor system.

Rotor System

The rotor system (figure 8) consists of a four-bladed, fully articulated *main* rotor and a *pair* of two-bladed teetering rotors that comprise the four-bladed tail rotor.

The main rotor head allows each of four blades to flap, feather, lead or lag independently of one another. Its major components are:

- hub assembly
- pitch housings
- strap assemblies
- rotor dampers
- lead/lag links.

The main rotor hub assembly (figure 9) supports and drives the main rotor blades. It is mounted to and supported by the static mast. Drive for the main rotor is from the transmission through the main drive shaft, to the drive plate, into the hub assembly.

An ADS mounts to the top of the main rotor hub at the cover plate. The main rotor hub is designed to permit the static mast to assume all flight loads, and allows for autorotation in the event the dynamic mast fails.

The pitch housing (figure 10) permits blade pitch changes in response to flight control movements transmitted through the swashplate. A feathering bearing and strap assembly mount the pitch housing to the hub assembly. A pitch change horn accepts pitch change motion from the rotating swashplate through an adjustable pitch link.

Feathering bearings are installed inboard on the pitch housing to allow for pitch change motion and to maintain pitch housing alignment (shear loading).

A lead/lag link is attached to the pitch housing, at the outboard end, by a hinge pin assembly, and mechanical droop stops are installed to limit main rotor droop of any one blade to 7 degrees.

The strap assemblies (figure 11, page 26) transmit centrifugal loads from the main rotor blades to the hub, and provide flapping and feathering capability. Each V-shaped strap assembly consists of 22 laminated stainless steel straps.

The main rotor blade (figure 12, page 26) primary load carrying member is a four-cell stainless steel covered box. Each box (spar) is made of unidirectional fiberglass material. The root end of the blade has doublers that transmit centrifugal blade loads into the root fitting, made of titanium. Removable tip caps protect the outer end of each blade, which is swept back 20 degrees. A static discharger mounted at the swept tip dissipates static electricity buildup and Nomex-honeycomb core fills the trailing part of the blade.

The tail rotor system (figure 13, page 26) is a dual, semirigid teetering design. It is splined to and driven by the tail rotor gearbox output shaft, which passes through the static mast.

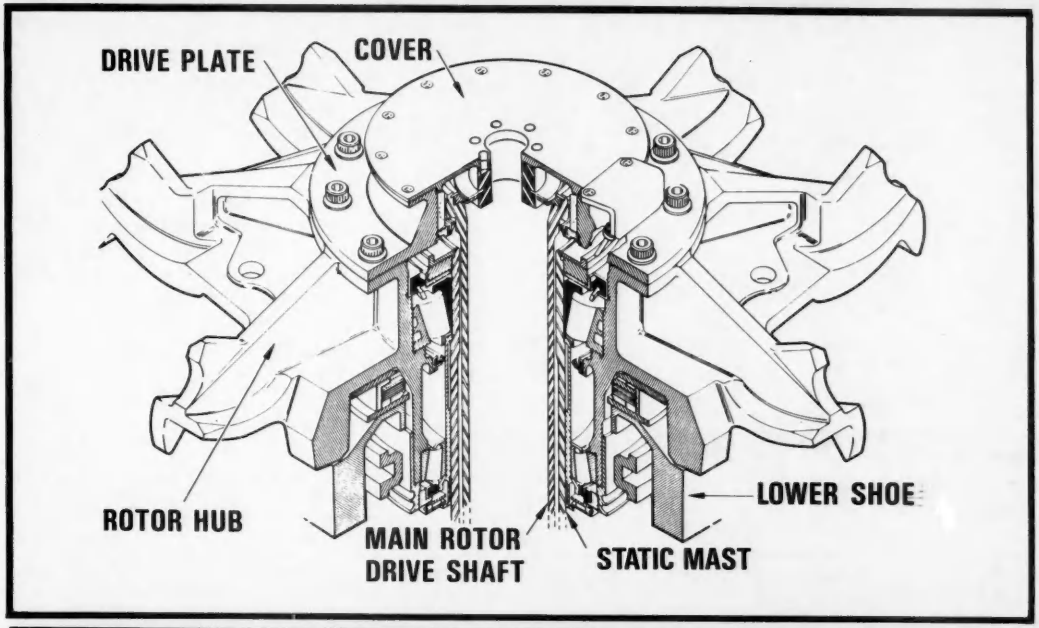

FIGURE 9: Main rotor hub assembly.

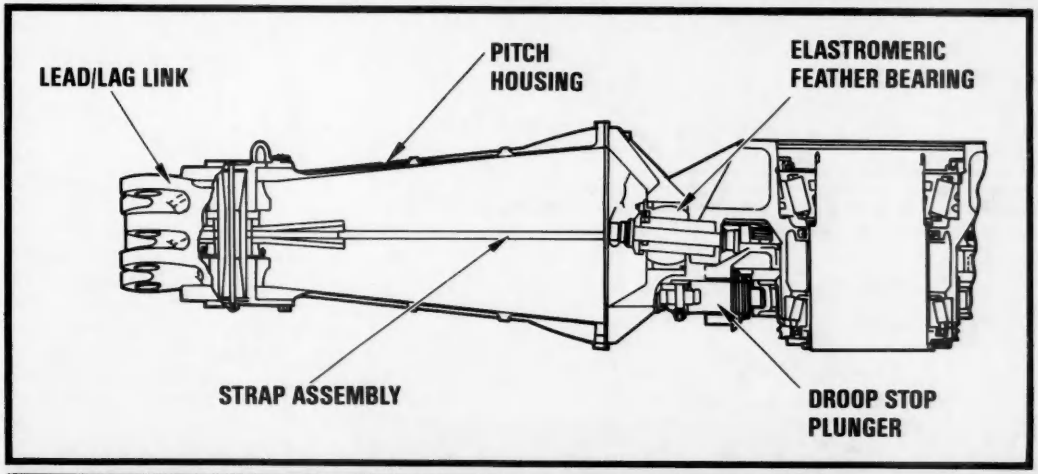

FIGURE 10: Pitch housing.

A titanium fork houses four elastomeric teetering bearings and drives the rotating swashplate, through an attached scissors assembly. Pitch changes are transmitted from the rotating swashplate to the pitch horn by pitch links and cause blade movement about two pitch change bearings installed in the blade root fit-

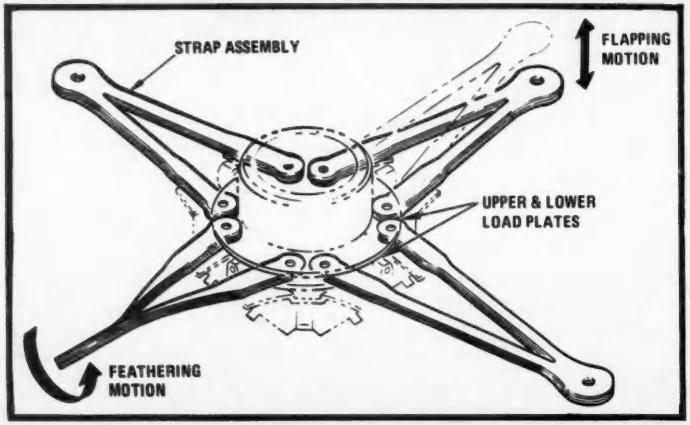

FIGURE 11: Strap pack.

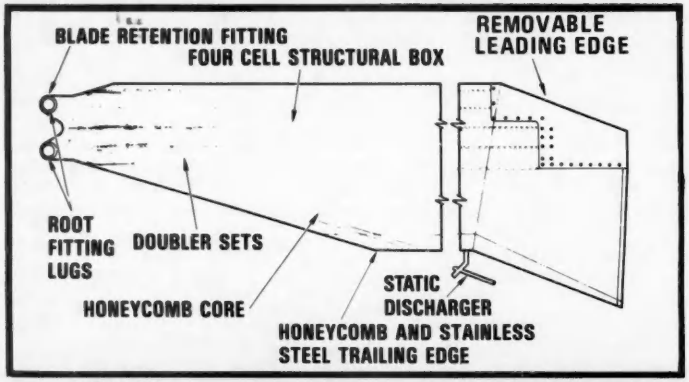

FIGURE 12: Main rotor blade configuration.

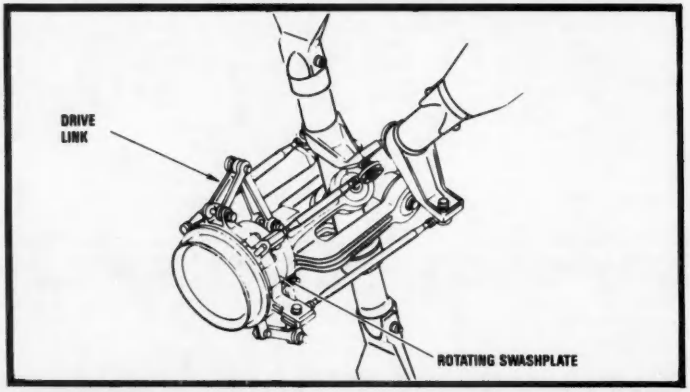

FIGURE 13: Tail rotor hub assembly.

tings. The angle formed by the intersection of the closest blades is 55 degrees.

Erosion protection for the main rotor blade is provided by the heavy gauge stainless steel leading edge that enables the blade to withstand strikes (without catastrophic damage) from branches 2 inches in diameter. Internal unidirectional fiberglass tubes lessen the rate of crack propagation.

Blade root fittings (upper and lower) and lead/lag links are designed so that any one blade attaching lug or any mating folding link lug pair can sustain a complete failure and still the remaining lugs will carry the design limit load.

Main rotor blade retention straps have damage tolerance due to the flexibility and high-strength/toughness of the strap material and the number (22) of laminations. The main rotor hub material is high-strength aluminum.

Two main rotor blade lead/lag dampers are provided on each blade. The elastomeric material of the damper is damage tolerant. With either damper out of action, the remaining damper is adequate for continued flight and landing.

Elastomeric lead/lag dampers provide damping of the inplane blade movement. The landing gear dampers alone can provide adequate fuselage damping to prevent mechanical instability (ground resonance) during ground operation. The pitch housing can lose one pitch horn lug or one lead/lag hinge lug and continue to operate satisfactorily for the duration of the flight.

Ground clearance to the main rotor blades is 120 inches, so that personnel may walk erect under the main rotor when the controls are centered and the rotor is turning.

During landings, the tail rotor is protected from damage in excessive tail down attitude by its position above the tailboom. Stabilator position and design also serve to protect ground personnel from the rotating tail rotor.

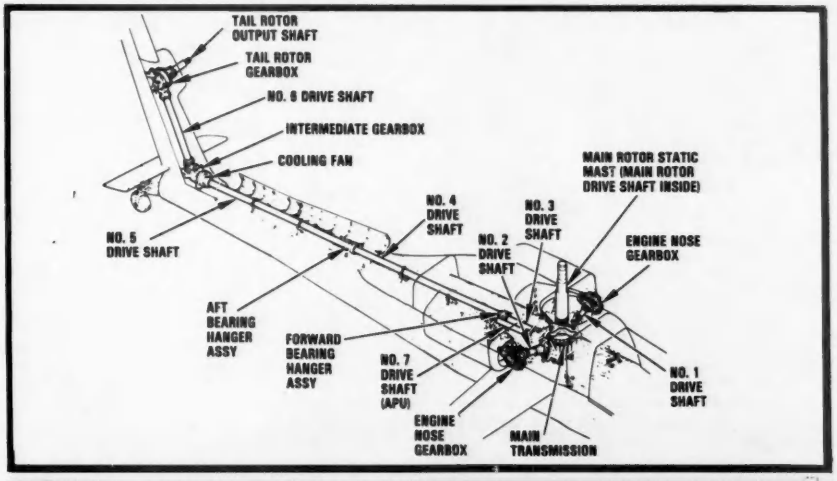

FIGURE 14: Drive system major components.

Drive System Major Components

The AH-64A helicopter uses several different components (figure 14) to transmit engine power to the main and tail rotors.

The main engines normally power the drive system through the nose gearboxes, input shafts, couplings and input quill clutches to the main transmission. Through gearing, primary powertrain drive for the accessory gearbox (AGB) is from the No. 2 engine. The primary powertrain drive for the tail rotor is from the No. 1 engine.

When the main engines are shut down, the auxiliary power unit (APU) is used to provide power to the transmission AGB. The APU power drives the AGB, which in turn drives two ac generators, two hydraulic pumps and the shaft driven compressor. The auxiliary power unit does not drive the main or tail rotor assemblies.

The major components in the drive system are:

- number 1 nose gearbox
- number 1 input shaft
- number two nose gearbox
- number two input shaft
- number three drive shaft (forward short shaft)
- number four drive shaft (forward long shaft)
- number five drive shaft (aft long shaft)
- number six drive shaft (tail rotor shaft)
- number seven drive shaft (APU shaft)
- main drive shaft
- main transmission
- intermediate gearbox (IGB)
- tail rotor gearbox (or 90 degree)
- cooling fan
- common couplings
- dampers and antiflail assemblies
- forward and aft bearing hangar assemblies.

Each nose gearbox (figure 15, page 28) is mounted to the engine main frame and coupled to the engine by a floating type quill shaft. The nose gear box fairing assembly is heated to prevent the formation of ice around the fairing and the gearbox.

A cooling fan is bolted to the nose gearbox output shaft adapter and cooling fins extend into the cooling air stream to dissipate heat build-up. The impending bypass (pop-up) button on the filter and the nose gearbox oil level sight plug are readily visible inside the fairing.

The transmission (figure 16, page 28) is driven by the main engines through two overrunning type input clutches that permit engine decoupling for autorotation or engine shutdown.

The main transmission (figure 17, page 28) provides the necessary change in direction of drive and reduces speed to drive a primary and accessory drive train. It is located below and attached to the main rotor support structure. The transmission accepts a torque load only. This design feature allows a lighter than normal transmission to be used.

Lifting and bending moments are transmitted from the main rotor, through the static mast and supporting structure, into the helicopter structure.

The transmission has a single stage planetary system with three stages of speed reduction within its primary

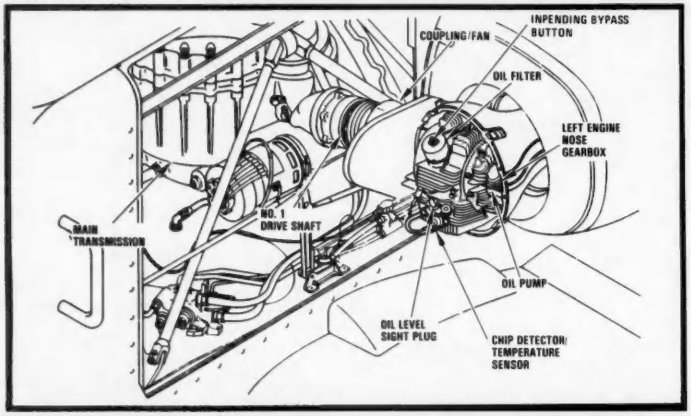

FIGURE 15: Nose gearbox installation.

gear train. An accessory gearbox mounted on the rear of the transmission can be driven by the main engines through the transmission, or by the auxiliary power unit through overrunning clutches inside the accessory gears.

Except for the primary oil pumps, diverter valves, chip detectors and temperature transducers, all of the major components (figure 16) are mounted on and driven by the AGB:

- two hydraulic pumps
- two ac generators
- shaft driven compressor
- tail rotor drive shaft output flange
- rotor brake disc assembly.

The magnetic pickup is also mounted on the gearbox to count the pulses of internal gearing, to be used as a rotor rpm (N_r) indicator.

Mounting of the rotor brake disc is through an overrunning clutch. Its gear teeth mesh with the right side intermediate cluster gear. When hydraulic pressure is applied to the brake actuator, the rotors are slowed and stopped through the primary geartrain.

The tail rotor output drive flange gear meshes with the drive gear for the magnetic pickup. This gear meshes with the left intermediate cluster gear.

Mounted on the top right side of the gearbox is the auxiliary power unit input flange.

Drive for the No. 1 generator also drives the shaft driven compressor and drive for the No. 2 generator also drives the accessory oil pump. The generators are held on by quick-disconnect assemblies that resemble V-band clamps.

Intermediate cluster gears drive the primary oil pumps. The chip detector/temperature sensors (left and right sumps) are the same as

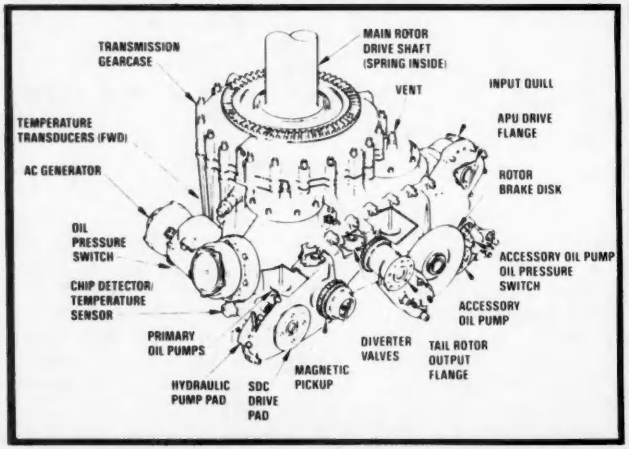

FIGURE 16: Main transmission components.

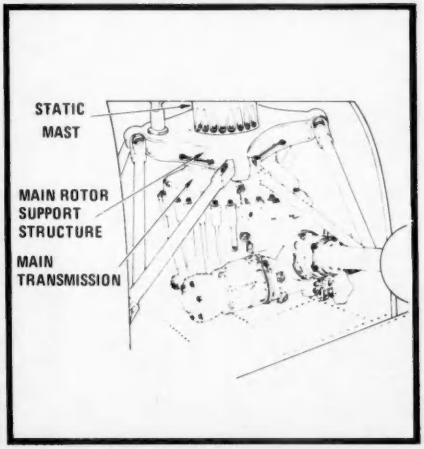

FIGURE 17. Main transmission installation.

those that are used on the nose gearboxes.

Two temperature transducers are mounted on the bottom front of the transmission to transmit oil temperature through the multiplex system as a fault detection/location system call-up by the copilot gunner.

The intermediate gearbox (figure 18) is mounted to the lower end of the vertical stabilizer. It provides for a speed reduction and a 71-degree angle of change in the tail rotor drive. The cooling fan is mounted to the input flange of the IGB with the diffuser mounted to the gearbox housing. The cooling fan draws air from the vicinity of the tail rotor gearbox and exhausts the warm air overboard at the IGB lower fairing.

A special grease is used to lubricate the intermediate gearbox. Since it is a grease, metal particles that might be present will not be affected by a magnetic chip detector. A vibration monitor and four thermistors (heat sensitive switches) are used to illuminate caution/warning panel segments TEMP INT and VIB GRBX.

The tail rotor gearbox (figure 19) is mounted to the vertical stabilizer and provides for a speed reduction and a 90-degree angle of change in the tail rotor drive.

A tail rotor drive output shaft is mounted inside the static mast. It drives the tail rotor assembly with only torque loads applied to the shaft. All other loads are absorbed by the static mast.

Four thermistors and a vibration monitor are used to monitor internal gearbox condition while the directional servoactuator, with some of its associated control rods and brackets, is mounted on top of the gearbox.

This article has addressed the features and characteristics of the AH-64A flight control system, rotor system and drive system. The next article in the Apache series will address the caution/warning system, the fault detection/location system and the multiplex data bus system.

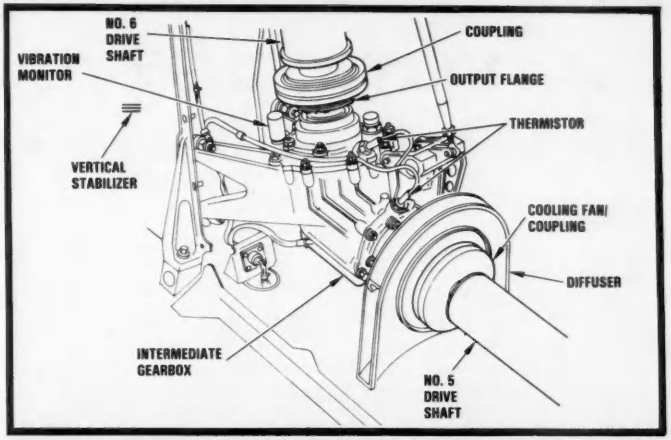

FIGURE 18: Intermediate gearbox.

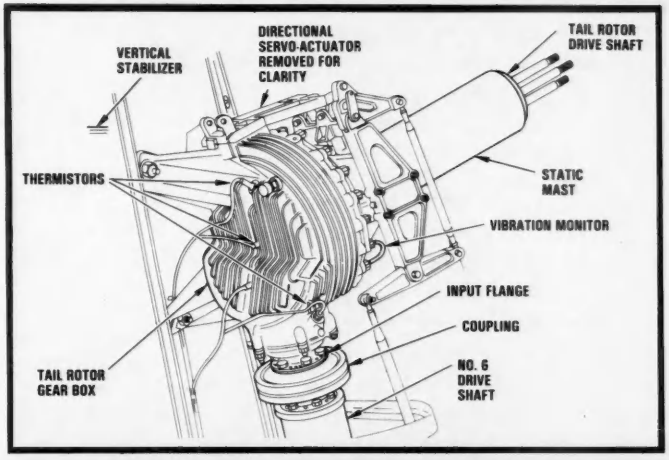

FIGURE 19: Tail rotor gearbox.

ABOUT THE AUTHORS

Mr. S. A. Austin has been a member of the McDonnell-Douglas Helicopter Company Apache team since leaving the U.S. Army in September 1979. His initial assignment was in engineering flight test in Yuma, AZ. Since moving to Mesa, AZ, in September 1983, he has been a member of the program managers office and is currently the program manager for AH-64 production at Mesa.

Mr. Austin has more than 20 years experience in rotary wing aviation. His military assignments included tours as a commander, instructor pilot, and test and evaluation project officer. He is currently a major in the U.S. Army Reserve.

Mr. John A. Moore is the training systems manager for the Product Support Division and is responsible for the design, development and presentation of programs that include light helicopter maintenance training as well as Apache maintenance and aircrew training courses. He has more than 18 years experience in aviation, both military and aerospace industry. He is a commander in the Naval Reserve, serving as a pilot with Helicopter Attack Squadron (Light) Five.

Since joining the company in 1980, Mr. Moore has held positions in both the Light Helicopter and Product Support Divisions.

AVIATION PERSONNEL NOTES

AH-64 Aircraft Qualification Course (AQC)

The obligations for the AH-64 Apache AQC have recently changed. Aviators who complete the course now incur a 3-year service obligation. Also, the course is now open to both Active Duty and Reserve Component aviators and to a select number of initial entry rotary wing (IERW) graduates who attend subsequent to IERW graduation. Aviators interested in attending the AH-64 AQC should apply through their respective personnel office to Military Personnel Center (MILPERCEN).

Pilots scheduled to attend AH-64 qualification at Ft. Rucker, AL, who require extra-large helmets should contact their assignments officer at MILPERCEN prior to departing home station and verify availability of extra-large helmets. The shortage should be resolved by the end of the 1987 calendar year.

MOS 93B Aeroscout Observer

The 10-month obligation incurred by 93B soldiers accessed from other military occupational specialty (MOS) (inservice accessions) has been changed recently to a 3-year obligation. This change is to ensure that the Army Aviation Branch receives full benefit from soldiers trained in the highly sought aeroscout observer MOS. It also aligns the inservice accession obligation with the initial enlistment obligation for the MOS.

CSM/SGM Selection Board

Aviation Branch soldiers did exceptionally well on the Fiscal Year (FY) 1987 Command Sergeant Major/Sergeant Major (CSM/SGM) Selection Board. The Army average for selection was 13.5 percent while the overall branch selection rate was 20.6 percent. The following is a listing of selection rates by career management field (CMF):

	Soldiers Considered	Soldiers Selected	Percent
CMF 28	15	2	13.3
CMF 67	127	26	20.5
CMF 93	66	15	13.5
Total Aviation Branch	208	43	20.6
Total Army	6,059	819	13.5

Aviation Intelligence Officers (15M)

On 29 May 1987, the then Chief of Staff of the Army, General John A. Wickham Jr., approved an exception to Officer Personnel Management System II (OPMS II) for aviation intelligence officers. This was accomplished after a joint 2-year effort by the U.S. Army Aviation Center, Ft. Rucker, and the U.S. Army Intelligence Center and School, Ft. Huachuca, AZ.

The approval allows aviation intelligence officers to acquire functional area training in one of the following three Military Intelligence (MI) areas of concentration (AOC): 35C (Imagery Intelligence), 35D (Tactical Intelligence) or 35G (Signals Intelligence/Electronic Warfare). By alternating between the 15M and 35 functional area assignments, aviation intelligence officers will be effectively using the dual-tracking option of OPMS II. They will, likewise, receive both the aviation and intelligence training necessary for the accomplishment of

both the special electronics mission aircraft and the aviation brigade missions. The three MI AOC will be functional areas only for 15M officers.

These 15M/35 officers will be competitive within both the Aviation Branch and MI for promotion, schooling and command. Particularly during the field grade years, they will be competitive for command of aerial exploitation battalions and MI ground units (within their respective MI AOC).

Lieutenant Colonel Command Selection Board Analysis

Aviators fared well on the latest Department of the Army Selection Board convened to consider lieutenant colonels and promotable majors for designation to lieutenant colonel command during FY 1988.

Of the 327 projected vacancies, 58 went to aviators (17.7 percent of the total). Selectees were from year groups 67 through 72, 70 being the predominant year group with 40 designations. Forty-two of the 58 selectees will command aviation related categories (aviation, air traffic control, aviation exploitation, aviation maintenance). The other 16 will command varied categories to include 4 as project managers.

Changes to Career Management Field(s) 67 and 28

On 30 March 1987, Major General Ellis D. Parker approved recommendations submitted by the CMF 67 (Aircraft Maintenance) Joint Work Group (JWG). The JWG determined its recommendations after examining reports from the field and comments provided by a panel of experts.

The resultant changes will affect the way the aviation enlisted force will be doing business in the future; duty positions associated with specific grades will change from the current structure. For instance, technical inspectors (TIs) will be staff sergeants only. Reasons for deletion of sergeant (E5) TIs center on lack of experience and historical malutilization as repairers. It is also felt that the authority associated with staff sergeants is required for this position.

Crewchiefs will be either specialists 4 (E4) or sergeants (E5), with the exception of MOS 67U, which requires a flight engineer (staff sergeant) and crewchief (sergeant). This exception is required because of the maintenance complexity of the CH-47 aircraft to which 67U personnel are assigned. There will be no privates first class used as crewchiefs and the staff sergeants will be used only as flight engineers (MOS 67U), TIs and supervisors.

These changes are designed to provide the commander with an experienced work force yet maintain a sufficient degree of flexibility. A significant benefit to soldiers will be the elimination of the current bottleneck in promotions via creation of a feasible structure for each MOS. Earliest implementation of these changes will be October 1988.

Also scheduled to occur in October 1988 is the combination of CMF 28 (Aviation Communication Electronics System Maintenance) with CMF 67. Originally considered because of the now current practice of integrating avionics into the flight systems of aircraft, the decision to combine the CMFs will have added benefits. The chief benefit of this change (for soldiers) will be increased opportunity for promotion. There will, likewise, be increased control of avionics training by the Aviation Branch, consolidation of all the aircraft maintenance functions and realignment of the grade structure for those currently in CMF 28.

Promotion opportunities will increase because of the grade structure realignment necessitated by combining the two CMFs. The capper MOS for avionic personnel will increase from the current rank of staff sergeant to sergeant first class. Currently, all the basic CMF 28 MOSs (35K, 35L, 35M and 35R) cap at sergeant and compete for promotion to staff sergeant within MOS 35P. The restructure also will allow avionic skilled sergeants first class to compete for the ranks of master sergeant and sergeant major along with MOS 67T, 67Y, 67R, 67U, 68J and 68K.

With the transfer of CMF 28 from the Signal Corps to the Aviation Branch, will come the training management function. Although actual training will remain at Ft. Gordon, GA, for some time, training content will be determined by the Aviation Branch. Also, advanced noncommissioned officer (NCO) training will be moved from Ft. Gordon to Ft. Rucker. Basic NCO training, however, will remain at Ft. Gordon because of its dependence on equipment shared with advanced individual training courses there.

Overall, the Aviation Branch will have a plus-up of almost 2,000 authorizations and increase the avionics

training base responsiveness to the field. One final benefit will be an increased competence of our maintainers as avionic and maintenance expertise are merged.

Multitrack Flight Training

On 12 May 1988, a signal day will be marked in Army Aviation training—the beginning of "multitrack." Multitrack will be the method of training all Army Aviation initial entry pilots now taught in the IERW course. It will also incorporate training currently accomplished through the AH-1 and UH-60 AQC.

Specifically, multitrack will be a consolidated, four-track IERW program. Primary and instrument training will be conducted in the venerable UH-1, completely eliminating the use of the TH-55. Combining the primary and the UH-1 transition phase saves 12.5 blade hours per student aviator and all the time spent learning TH-55 specific knowledge/skills.

After instrument training, students will begin combat skills training in one of four aircraft (UH-1, OH-58, UH-60 or AH-1). As a result, numerous benefits will be derived. Each graduating flight class will provide aviators who are fully qualified in one of the Army's four primary aircraft. There will be a saving in the costly man-hours now required as aviators return TDY for qualification into the AH-1 or UH-60. Also, the training is more detailed, giving AH-1/UH-60 students about three times as many flight hours than now allotted in AQC. This increase in flight hours is due to consolidated training and does not reflect any significant plus-up of overall flight hours.

Once multitrack is initiated, AQC quotas for the AH-1 and UH-60 will be limited. Both MILPERCEN and the Aviation Center will closely monitor quotas for those courses relative to the needs of the Army and the professional development needs of the Aviation Branch. Furthermore, commissioned officers can expect increased emphasis on aircraft qualification being a major factor in assignments.

Aviation Unit Maintenance Company (AUMC) Approved

On 4 May 1987, the Chief of Staff of the Army approved the creation of the AUMC. This decision will align more closely the aviation logistics force structure to that of the Aviation Branch.

Originally, the transition of the Aviation Branch to J series Modified Tables of Organization and Equipment brought about a restructure of aviation units and, for the first time, aviation companies were commanded by captains. In contrast, aviation maintenance platoons retained platoon designation within headquarters and headquarters company organizations, even though often larger than the companies they supported.

As a result of the Chief of Staff's recent decision, 46 active component aviation unit maintenance platoons will become AUMCs commanded by captains. Additionally, there will be 28 National Guard and 11 U.S. Army Reserve platoons converted to the new maintenance companies. Thus, not only is the force structure aligned but an increased avenue is provided for the 15T aviation logistician to obtain company command. These changes will impact table(s) of organization and equipment structure for four basic types of units: attack battalions, command aviation battalions, reconnaissance squadrons and assault battalions.

VIEWS FROM READERS

Editor:

I thought Mr. Aaker's article on the Volcano mine system in your November [1986] issue was well deserving of your monthly writing award.

However, it also brought to mind an old question related to the fielding of such new systems: Are we prepared to transport, store, maintain, install, check-out and employ such items as the Volcano when they are added to a unit's TOE?

Our past record has not been good, and I suspect it is not much better today with the current manpower ceiling and leaner TOEs. But the fact remains, any new widget that adds weight, bulk and complexity to an organization detracts to some degree from that organization's overall efforts unless corresponding resources (people and things) are provided for the "care and feeding" of the new widget being added.

While the potential for increasing combat or training effectiveness is usually real and apparent based on the face value of the widget alone, this positive potential can quickly become negative potential as finite TOE resources are spread thinner and thinner in an attempt to *care and feed* a growing list of widgets.

I too believe the Volcano is a superb system with positive battlefield payoff, but is it coming with the needed resources to *care and feed* it? How much additional bulk, weight and maintenance will the UH-60 company commanders have to be prepared to take on? And do not forget that other systems are going to arrive either before or after the Volcano on their doorstep. Systems that will carry their own "care and feeding" problems; systems like the extended stores support system for maintaining self-deployment readiness and the UH-60 HELLFIRE system. The *care and feeding* of these systems is not just a company commander's concern. It is a justifiable concern for commanders at all levels; it impacts on readiness and combat effectiveness and warrants some tough questioning on how these systems are to be supported within not only the company, but within the battalion, brigade and division.

Combat potential, like any potential, is only good if it can be properly exercised in a timely manner. So the question remains: Can all those forthcoming "enhancement" systems be properly employed without an adequate *care and feeding* base within the UH-60 company? I believe it's a basic question in search of a clear answer.

COL Clark A. Burnett (USA Ret)
Enterprise, AL

Editor:

On 12 April 1987 a 35-year-old H-19 helicopter arrived at Ft. Rucker, AL, for permanent duty assignment at the Army Aviation Museum.

The new addition to the museum is the result of the thousands of dollars contributed by friends of Army Aviation in the Wiregrass Area, as well as those who contributed from almost every other state in the USA and, from a few countries overseas as well.

It was the goal of the surviving members and the widows of members of the first three classes of warrant officer helicopter pilots to see this old helicopter consigned to a place of honor in Army Aviation history. Now after nearly 5 years of struggle, it has been accomplished and we thank you.

George Bolton

Editor:

The USAF Survival School would appreciate your assistance in our survival interview program. By printing the request below for survivor information, you will be helping us obtain factual stories for our instructors to use during student training.

COL Robert W. DeSanto Jr.
Director, Flight Operations
HQ, Air Training Command
Randolph AFB, TX

Do you have a survival story you would like to share? We are looking for people like you who have experienced a survival episode, either military or civilian, which can be used to enhance our training. We will use your valuable experience to let others know what might be expected and how they might feel. Please contact us at 3636 (CCTW/DOV, Fairchild AFB, WA 99011-6024, AUTOVON 352-2371/2171 or Commercial 509-247-2371/2171.

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Maintenance Specialization—

The Other Side of the Coin

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Fort Monroe, VA

This article expresses the views of the author and does not necessarily reflect those of the Department of the Army nor any of its agencies.

I READ WITH much interest the article by Major (P) Stephen J. Snow and CW3 Gerard F. Franklin in the August 1986 *Aviation Digest*, entitled "Maintenance Specialization—A Combat Multiplier, or a Combat Inhibitor?" They should be commended for their obvious interest in the logistical welfare of Army Aviation. Too often concerns remain in the hearts and minds of the holder. Unless articulated and brought to the attention of those who can effect either a solution or an explanation, these concerns fester and frustrate. Thanks MAJ Snow and CW3 Franklin for bringing your concerns out for scrutiny. Now let's discuss their concerns.

With the cessation of hostilities in Vietnam and a return to a "peacetime" Army, we expected to see a marked increase in the major parameter with which we measure the effectiveness of our aircraft maintenance program in the Army, i.e., readiness. This did not occur; in fact, quite the opposite. All the factors that influence readiness, and readiness itself, declined.

In 1980, under charter from the Vice Chief of Staff, U.S. Army (VCSA), the Deputy Chief of Staff for Logistics (DCSLOG) of the Army initiated an indepth study under the stewardship of Mr. Joseph P. Cribbins, Department of the Army, DCSLOG Aviation, to seek out reasons for this decline and possible solutions. This 18-month effort, commonly called the Vines Study after the study group chairman, Colonel Pete Vines, looked at all aspects of aviation logistics. Force structure, military occupational specialty (MOS) structure, training, incentives and equipment were exhaustively studied. The study found that multiple systemic shortcomings existed, which resulted in an overall decrement of aviation readiness. It is important to note that the problems discovered and the solutions, proposed and approved by the VCSA, were multifaceted and resulted in the revision of the career management field (CMF) 67 from top to bottom, from force structure to personnel management, and from training to incentives. Enough history, let's move on to specific concerns addressed in the article.

Specialization was one of the results of the CMF 67 revision. With the introduction of the 66 series technical inspector (TI), we broadened the depth of expertise each soldier had with his specific aircraft. In this perspective, the term "narrow rang-

ing" might be a misnomer. They are narrow in scope, but broad in depth. This solution addressed the increasing complexity of Army aircraft, which the authors acknowledge.

It was recognized then, as now, that use or misuse of austere assets was a problem. During the course of the study, 30 to 40 percent productive use of technical skills for their intended purpose was the norm. The revision specifically created a system to identify and assign by Military Personnel Center the right person for the right job. It appears from the content of the article that the problem of misuse has not gone away. We cannot legislate common sense, and common sense tells us that we cannot misuse the limited assets available.

I would like to correct a misunderstanding the authors appear to have regarding the capabilities and limitations of the 66 series TIs. They ask the question, "Why not permit these highly motivated professionals to expand their capabilities by permitting them to inspect all types of aircraft . . ." and uses "the inspection of pitch-change links or common safeties" as an example of what the 66 series cannot do. It was not then, and is not now, the content or intent of regulatory guidance to so encumber the unit. In the absence of a particular 66 series TI, another series 66 is more than qualified, both by training, experience and temperament, to accomplish the inspection task. Properly using the manuals, which is a large part of the 66's training, no other person in the unit should instill more confidence in the commander that the work has been correctly accomplished.

Various attempts have been made to include all the skills and tasks for all aircraft in the schoolhouse instruction. The limiter becomes time and the ability of the student to assimilate information. A typical single MOS course now runs in excess of 14 weeks of intense technical training. To submit a student to the additional weeks required to teach, in detail, other aircraft would not be cost effective. Even if it were, studies on the learning process lead us to believe that the majority of students could not assimilate the resultant training material. The best that can be expected, given the ever-increasing complexity of our systems, is a concentration of instruction in specific areas and the establishment of a basic understanding in other areas. Given the quality of our students as reinforced by feedback from the field, they are more than capable of transferring this basic understanding to multiple and diverse duties. The "theory and concept" training the authors propose is an interesting approach; however, it presupposes that the time exists to convert the "theories and concepts" to hard skills and task accomplishment. The field wants and deserves a "doer," and that is what they tell us they get from the schoolhouse today.

Just a brief note on the 67Z sergeant first class. Prior to the CMF 67 revision, it was not uncommon to find a 67Z who grew up as an AH-1 Cobra mechanic, section leader and assistant platoon sergeant who is now, as an E7, a CH-47 Chinook platoon sergeant or fixed wing detachment sergeant. Some did well; others did not. By tracking soldiers in a two-aircraft family and then assigning them against an E7 position in that two-aircraft family, we were able to overcome the lack of technical expertise that previously existed. As can be seen by your article, we are misusing our E7 supervisors, despite the fact that systemically they should not be assigned to those positions. Perhaps use and management are the offenders of which the authors speak rather than the entire system.

It should be noted that the CMF 67 revision has only been implemented for about 2 years. The transition was programed to take 3 years since the training to produce the requisite number of 66 series technical inspectors must be scheduled based on the field's capability to program students for it. Training initially lagged behind due to the numerous no shows at the schoolhouse. A command can hardly expect to reap the benefits of a program they have elected not to participate in. As more 66 series TIs are trained, shortages of TIs should diminish unless we misuse those whom we have trained.

One editorial note regarding the studies that were referenced in the article. The Electronic Maintenance Structure Study does address the aviation electronic and armament MOS as well as electronic ground equipment. The ongoing MOS consolidation study for MOSs 68J, 68M and 68F, and 35K is a parallel effort. If it gains some economy by wisely consolidating duplicated tasks, then it should be investigated. Economy without sacrificing quality should be a goal for all of us. However, analysis should be extensive and based on facts. The Frietag or U.S. III study concluded that in aviation, the only issue was whether or not 68 series skills should be in the aviation unit maintenance (AVUM) units. The Aviation Logistics School has recommended that they remain at the AVUM level due to a definitive need for their skills there.

Our frustrations as operators are real. We sometimes attribute the reasons for these frustrations to the wrong causes, but nevertheless, the frustrations are real. I would challenge everyone concerned in the personnel, force structure and operation of aviation to do their part to ensure that we remain Above the Best.

AVIATION LOGISTICS

Noncommissioned Officer Education System Realignment

Master Sergeant Larry Mitchell

ESTABLISHMENT of a new aviation career management field (CMF) 67/68 Basic Noncommissioned Officer Course (BNCOC) as part of the noncommissioned officer education system (NCOES) realignment was directed by the commander, U.S. Army Training and Doctrine Command in July 1985. The Department of NCO Training, U.S. Army Aviation Logistics School (USAALS), Ft. Eustis, VA, implemented the first new class of resident aviation BNCOC in April 1986.

This completely new course has incorporated a common-core leadership phase of instruction developed by the U.S. Army Sergeants Major Academy. The course stresses leadership skills as well as military occupational specialty (MOS) specific skills required for the skill level 3 aviation NCO to lead and train subordinate soldiers. Aviation soldiers who have not attended either the old Basic Technical Course or the new BNCOC should aggressively seek to attend this new basic resident course as attendance became a requirement for the Advanced Noncommissioned Officer Course (ANCOC) selection beginning on 1 October 1986.

Under the NCOES realignment there will be four levels in the NCOES: the Primary Leadership and Development Course, the Basic Noncommissioned Officer Course, the Advanced Noncommissioned Officer Course, and the U.S. Army Sergeants Major Academy. Effective 1 October 1986, attendance at the advanced course level will be a requirement for promotion consideration to master sergeant for sergeants first class with a date of rank of 1 April 1981 or later. This requirement will not apply to sergeants first class with a date of rank of 31 March 1981 or earlier because of practices and policies that existed prior to that date.

Aviation unit first sergeants, command sergeants major and commanders at all levels must become aware of all the requirements of the new NCOES and they must strive to establish counseling policies for NCOs eligible to attend any of the four levels of instruction. With the implementation of the new progressive and sequential NCOES, aviation noncommissioned officers, as well as their counterparts in other CMFs, have for the first time the same opportunities for professional development education that have existed within the officer corps for several years.

Aviation enlisted soldiers must become educated in the requirements of the new NCOES during the earlier stages of their careers as these requirements are directly linked to their promotion progression. The responsibility for providing this education rests with the senior noncommissioned officers of today. Prior to attending the resident BNCOC or ANCOC, NCOs must be prepared both physically and mentally to meet the challenging demands of the course.

Past experience indicates aviation NCOs reporting for ANCOC/BNCOC are for the most part not technically prepared for the advanced instruction. This is especially critical to the aviation NCO because of the degree of technical knowledge and proficiency required for successful completion and graduation from the courses. This lack of preparation is due in part to an erosion of lower-level skills acquired in previous aviation maintenance courses and in job experiences—a situation that resulted from the improper use of NCOs in field assignments, a lack of good SQT training programs, and the restructuring of CMF 67.

The restructuring of CMF 67 resulted in mass reclassification of aviation senior NCOs, many of whom were reclassified into a new systems MOS and then received virtually no training. The resulting void in experience placed these supervisors and platoon sergeants in a situation where they had to rely totally on subordinates for the technical expertise necessary to successfully accomplish the mission. That created a perception of weak leadership at the supervisory level.

An excellent management tool for platoon and higher-level field managers to assist senior NCOs in overcoming this training void is the skill level 1/2 job book. Using tasks extracted from the soldier's manual for a particular MOS, the job book lets managers know where their training weaknesses are and assists them in developing a unit training plan to overcome resident training shortfalls.

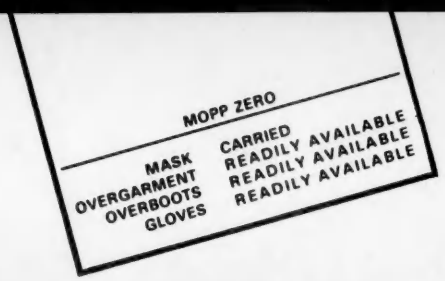
Currently, CMF 67 ANCOC/BNCOC students receive training in:

- The Common Leader phase that is offered by the NCO Academy.
- The Aviation Maintenance Management phase offered by the Department of Advanced Aviation Logistics Training (formerly the Department of NCO Training), USAALS.
- The Aviation Maintenance Technical Tracks phase offered by the MOS proponent academic training department, USAALS.

The Department of NCO Training, USAALS, under the direction of the Aviation Branch chief and the assistant commandant, will continue to provide the most up-to-date professional development resident training possible to the aviation noncommissioned officer.

ABOUT THE AUTHOR

MSG Larry Mitchell served as the NCOIC, Department of Noncommissioned Officer Training, U.S. Army Aviation Logistics School, Ft. Eustis, VA, at the time he wrote this article. He is currently assigned as first sergeant to the 82d Aviation Brigade, Ft. Bragg, NC.



NBC DEFENSE

in Aviation Operations

SHORTLY AFTER graduation from the Chemical Officer Basic Course, 1 February 1984, I was assigned to the 228th Attack Helicopter Battalion (AHB), 1st Cavalry Division. The 228th AHB at that time was the first J-series unit of its kind in the U.S. Army. As the chemical officer and assistant S3 for this newly activated unit, I found myself faced with an NBC (nuclear, biological and chemical) defense dilemma.

The Chemical Officer Basic Course had offered virtually no information on NBC defense with respect to Army Aviation. I immediately produced an NBC defense annex to the tactical standing operating procedure to meet the requirements for normal ground operations. But, I realized that NBC defense for an aviation unit must extend beyond normal ground operations.

The Defense Annex

The unit needed an additional NBC defense annex tailored to meet its mission requirements. To develop it, I had to learn all aspects of aviation tactical operations, maintenance, arming and refueling, gunnery and training. One year later, in January 1985, after several major field exercises and one National Training Center rotation, I developed an NBC defense annex specifically designed for aviation operations. Initially, there were 11 appendices. Then, in November 1985, I developed a 12th appendix and deleted the 11th.

Appendix 1, Warning and Reporting System, was developed specifically for aircrews. I learned that because of the cramped conditions in an aircraft and the limited time available (due to high mobility) to aircrews to react to NBC hazards, a simplified warning and reporting system was needed for helicopter missions. Recording and reporting NBC hazards with the use of GTA 3-6-2 (now GTA 3-6-3)* proved to be too time-consuming and awkward while in flight. This appendix also includes a communications traffic layout. The elements included in this traffic are the tactical operations center with the chemical section, airborne aircraft, forward arming and refueling points (FARPs), jump FARPs, aviation unit maintenance (AVUM) and aircraft in battle status (BS) 1, 2 and 3.**

* GTA means graphic training aid. It is a pocket-size foldout card that contains all the necessary data for preparing NBC reports.

** BS1 is a battle status in which aircraft are lifting off, or are ready to lift off, in order. BS2 is 5 minutes lift-off notice. BS3 is 10 minutes lift-off notice.

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FIGURE 1: Mission oriented protection posture (MOPP) levels (from FM 3-100).

Appendix 2, NBC Attack Recognition, informational in nature, was taken from various publications. It was developed with the consideration that aircrews are in a noisy environment and must rely almost totally on visual recognition of biological attacks and hazards.

Appendix 3, Contamination Detection, is also informational in nature. It describes onboard detection of contamination based on the availability of unit detection equipment. It also describes the placing of M9 Chemical Detection Paper throughout the aircraft fuselage for each type of aircraft. I included a strip of M9 paper to be attached to the windshield for easy detection by the aircrew. This strip is attached facing inward and taped on three sides with the top side left open to allow exterior contamination to enter between the paper and the windshield. Also, a strip is attached to the left skid of each aircraft for easy detection by ground crewmembers.

Appendix 4, Protective Actions, consists of information from various sources including Army aviators. I organized the information into actions to be conducted before, during and after an NBC attack for the sake of procedure clarity.

The probability of aircraft becoming contaminated on the battlefield cannot be ignored. Every available aircraft is needed as a battle intensifies. Hence, a contaminated aircraft cannot be discarded. It may become necessary at times to rearm and refuel contaminated aircraft as well as service contaminated aircraft for battle damage. In anticipation of such events, I developed *Appendix 5,*

FARP and AVUM Operations. It is a step-by-step procedure for contamination avoidance at the FARP and at the AVUM section.

Appendix 6, Aircraft Decontamination, contains two aircraft decon procedures:

- The first phase is limited, enabling contaminated aircraft to rearm, refuel and continue their present missions.
- The second also is limited, but has some added detail. It allows aircrewmembers to use the aircraft for further missions at MOPP (mission oriented protective posture) level (see figure 1, pages 38, 39). It also describes an aircraft decontamination team, covering its equipment and people, along with their responsibilities for conducting an aircraft decon site.

When I produced this annex, the second draft of FM 1-102, "Army Aviation In An NBC Environment," had been fielded. An aircraft decon site is described in FM 1-102, but is not feasible for use by an attack helicopter battalion, J-series. So, it was necessary to develop aircraft decon procedures unique to this unit.

Appendix 7, Performance Degradation Data, taken directly from FM 3-4, "NBC Protection," serves as a training and tactical information source for aviators. During my studies, I learned that aircraft required certain maintenance checks after applying large amounts of water to them. These checks are to be conducted by the respective aircraft technical inspector. So, I developed *Appendix 9, Post Decon Maintenance*, to ensure that unit aircraft would be functionally safe for flight after exiting decon sites. [Appendix 8 is not germane to this article.] In aviation units, much of the communication between air and ground crews is accomplished with arm and hand signals. Hence, it's necessary to clarify certain signals with respect to NBC defense. They appear in *Appendix 10. Appendix 12, NBC Survey and Security Team*, is the most recent addition to this annex. It allows for an expedient occupation of a forward assembly area (FAA), describing the organization, responsibilities, preparatory measures and actions of the NBC survey and security team.

Warning and Reporting.

Elements included in the warning and reporting system are airborne aircraft, FARP, jump FARPs and all aircraft in BS 1, 2 and 3. Also, the AVUM section is warned if incoming aircraft are contaminated and in need of battle damage repair. The battalion's chemical section maintains the capability to implement the NBC warning and reporting system in the following manner:

- Upon acknowledgement of an NBC attack or hazard in the battalion area or in the vicinity of the FARP, the chemical section warns the battalion commander in his airborne command post (CP), other commanders and airborne aircraft crewmembers, and all aircraft in BS 1, 2 and 3. From the airborne CP the commander transmits the warning to all aircraft under his control. Depending on the tactical situation, specific instructions also are sent (figure 2).
- Those in the chemical section monitor all applicable nets. Upon receipt or interception of an NBC attack or hazard, they transmit the warning.
- Upon observation of an NBC attack, airborne aircraft crewmembers report to their leaders who in turn report the observation to the battalion commander in his airborne CP. He in turn transmits the report to the battalion tactical operations center (TOC), which in turn warns other airborne aircraft crews as well as those whose aircraft are in BS 1, 2 and 3. Other airborne aircraft crews that observe NBC attacks transmit the warning directly to the battalion TOC (figure 3).
- If incoming aircraft are contaminated, the chemical section crew warns those in the FARP, the jump FARPs and the AVUM section. The warning from the chemical section does not relieve these elements of their responsibilities to practice contamination avoidance procedures.
- Warnings are sent only after protective actions, if needed, have been accomplished. Warnings from the chemical section include (but are not limited to) the type, location, extent and probable duration of the NBC attack or hazard. Reports from airborne aircraft crews include at least the type and location of the NBC attack or hazard. Nuclear and chemical STRIKWARNs (strike warnings) are not transmitted in the clear to airborne aircraft. Rather, these messages are sent by the use of a brevity code along with specific instructions.

Protective Actions.

Nuclear: Four primary effects of a nuclear weapon burst to be aware of are the blast, thermal radiation, initial and residual radiation, and electromagnetic pulse (EMP).

Before a nuclear burst, if forewarned, the battalion's aircraft are placed in revetments or behind barricades if they are available. This is unlikely except in the case of a static battle. Aircraft are tied down, if time allows. Windows and cargo doors are opened. If the aircraft is airborne and there is sufficient time to do so, it is placed on the ground with the

forward fuselage turned away from the pending blast. If possible, terrain masking is used. Visors are adjusted down and crewmembers slouch in their seats as low as possible to get their heads down and still maintain control of the aircraft.

During a nuclear attack calculations of range and location of the blast are not attempted. If the aircraft cannot be safely landed it should be flown away from the blast as a full-power climb is inititated. This action decreases the effects of secondary missile damage and increases the distance between the aircraft and the nuclear detonation. The altitude must be reduced as soon as possible if there is any chance of encountering an air-to-air or air defense weapon systems threat.

After a nuclear burst, aircrews must stay in the aircraft to await the positive and negative blast waves. If still airborne, the aircraft must be landed at the nearest safe location. After the blast waves have passed, the aircraft airframes are checked for structural damage, as are instruments for likely damage by EMP. The nuclear detonation is reported to higher headquarters and the mission is continued if possible.

Chemical: Chemical contamination is the most difficult to remove from aircraft. Therefore, special measures must be practiced to avoid contamination as well as the unnecessary spread of contamination.

If forewarned, aircraft should be flown away from the threatened area. If the mission requires aircraft to be returned, or flown into the area of pending contamination, the MOPP level IV must be maintained. Window and cargo doors are kept closed as the mission is continued. During the attack, personal first aid may be required.

After the attack, personal decon may be necessary and a report must be transmitted to higher headquarters. If the aircraft is contaminated, decontamination of aircraft is re-

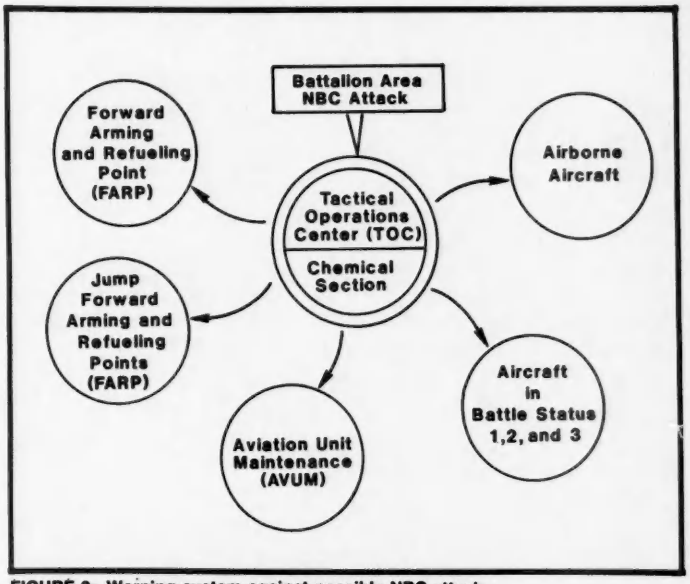
Battalion Area NBC Attack
Forward Arming and Refueling Point (FARP)
Tactical Operations Center (TOC)
Chemical Section
Airborne Aircraft
Jump Forward Arming and Refueling Points (FARP)
Aircraft in Battle Status 1,2, and 3
Aviation Unit Maintenance (AVUM)

FIGURE 2: Warning system against possible NBC attack.

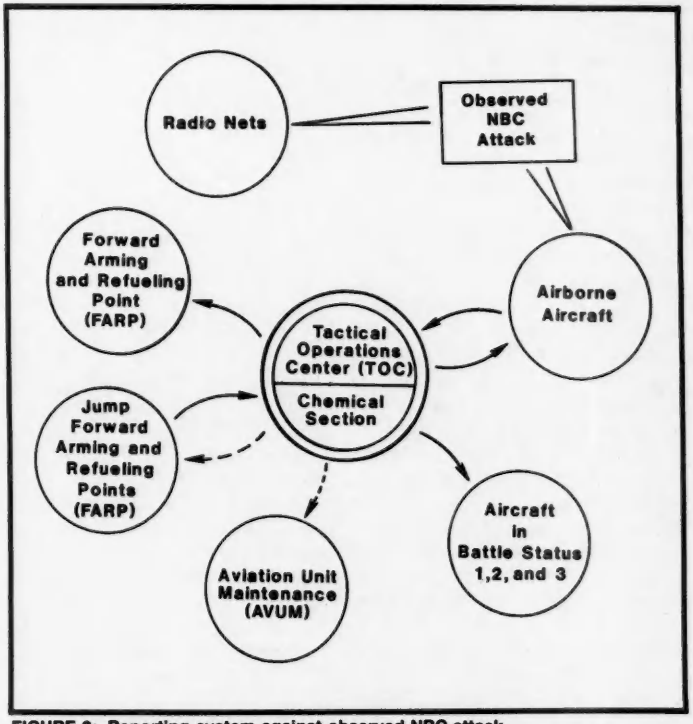
Radio Nets
Observed NBC Attack
Forward Arming and Refueling Point (FARP)
Airborne Aircraft
Tactical Operations Center (TOC)
Chemical Section
Jump Forward Arming and Refueling Points (FARP)
Aircraft in Battle Status 1,2, and 3
Aviation Unit Maintenance (AVUM)

FIGURE 3: Reporting system against observed NBC attack.

quested and coordinated. While the aircraft is in flight outside of the attack area, its windows may be opened, which decreases the amount of contamination within. The mission is continued if possible.

Biological: Recognition of a biological attack may be difficult while airborne. But, if it occurs the protective actions are identical to that of a chemical attack.

FARP And AVUM.

FARP. Upon actual or suspected contamination, aircraft should not enter the FARP area before undergoing decontamination. Doing so only spreads contamination. But, if the mission is critical and the situation dictates the necessity to enter the FARP, the following procedure (at a minimum) is used to limit the spread of contamination.

The aircraft is positioned short of the rearm or refuel point. Its aircrew alerts the FARP ground crew of the suspected contamination with an arm and hand signal, by flashing landing lights, or by flashing colored cards from within the aircraft.

Upon warning of an incoming contaminated aircraft, the FARP ground crew initiates MOPP level IV. FARP personnel quickly check the M9 paper on the airframe for color changes (this is done for all incoming aircraft). If radiological contamination is suspected, the AN/PDR-27 series Radiac Set is used to quickly scan the aircraft. If contamination is detected, the ground crew performs spot decontamination of fuel ports and mounted weapon systems. Also, the ground crew signals the aircrew that the aircraft is indeed contaminated.

The crew remains in the aircraft to avoid contamination transfer into the cabin. Aircraft cabins and cargo holds present a limited transfer area if windows and cargo doors are kept closed. If the aircrew must exit the aircraft, the ground crew performs spot decontamination of areas touched by the aircrew. Aircrewmembers will decontaminate themselves prior to reentering the aircraft.

Upon completion of rearming or refueling, the contaminated area is marked with the appropriate NBC marker. Depending upon the spread of contamination, the people and equipment in the FARP may need to be decontaminated and relocated.

AVUM: Because of the persistency of aircraft contamination, it is quite likely that aircraft maintenance people and equipment will be exposed to contamination during maintenance and battle damage repairs. To preclude the spread of contamination, the following measures discussed below (at a minimum) are conducted.

Aircrews warn the maintenance people about the contaminated aircraft. The maintenance crew initiates MOPP level IV before anyone approaches the contaminated aircraft, which first are moved to an area that prevents a downwind hazard to the battalion area and maintenance area. The spread of contamination is limited by touching and handling only those necessary areas. Spot decontamination of equipment and parts is done before and after the aircraft has been repaired.

Aircraft Decontamination.

Decon Team: The aircraft decon team consists of five people—a team leader, an M12A1 Decon Apparatus operator, and three decon team members. The leader is a trained NBC noncommissioned officer who is responsible for supervising the aircraft decontamination operation. The vehicle mounted M12A1 Decon Apparatus operator operates and maneuvers the decon apparatus and distributes decon materials. The decon team members decontaminate aircraft and ground-guide them into and out of decon sites. Two team members conduct a lubrication and functions safety inspection. The decon team provides the battalion's aircraft decontamination needs.

The two phases of aircraft decontamination are:

- Phase I, mission sustainment decon, is used to reduce contamination on an aircraft to expedite rearming and refueling. It enables aircraft to quickly return to the battle and accomplish their missions.
- Phase II, combat sustainment decon, is used to decontaminate aircraft to a greater degree than Phase I and prepares aircraft for further missions at a greatly reduced MOPP level.

Phase I: Upon occupation and organization of an aircraft decon site, an aircraft is ground-guided onto the site (figure 4). A team member quickly applies hot soapy water to the mounted armaments. Meanwhile, the vehicle mounted decon apparatus is positioned at a safe distance near the aircraft. Using a hose, another team member sprays the aircraft with warm soapy water, then rinses it down. The decon apparatus is carefully moved away from the aircraft and two team members quickly conduct a brief lubrication and safety check. Afterwards, the remaining team member directs the aircraft on its departure route.

If more than one aircraft requires decontamination, a holding area is established and a ground guide controls aircraft in and out of the holding area. When an aircraft enters the decon site, its M9 paper is checked to verify whether decontamination is required. For radiological contamination, an AN/PDR-27 Radiac Set

is used. If contamination is not detected, the aircraft is quickly rinsed down and directed on its departure route.

Phase II: At a Phase II decon site, aircraft are guided onto several staggered positions (figure 5, page 44). Team members approach the first aircraft with buckets of dry cloths. The decon apparatus is positioned a safe distance from the aircraft. Team members wipe the airframe and mounted armaments with soap-wetted cloths. Warm soapy water is applied beginning with the canopy and working top-to-bottom. The aircraft is then rinsed down, taking special care to avoid spraying directly onto the pitot static system and the electrical compartment.

Team members decontaminate themselves, then enter the aircraft and wipe down the instruments with dry cloths. The seats and floor are wiped with wet cloths. Upon completion of interior decontamination, doors, windows and canopy are closed (if contamination is still detected within the cabin they are left open to allow ventilation). The decon team moves to the next aircraft and conducts the same procedure.

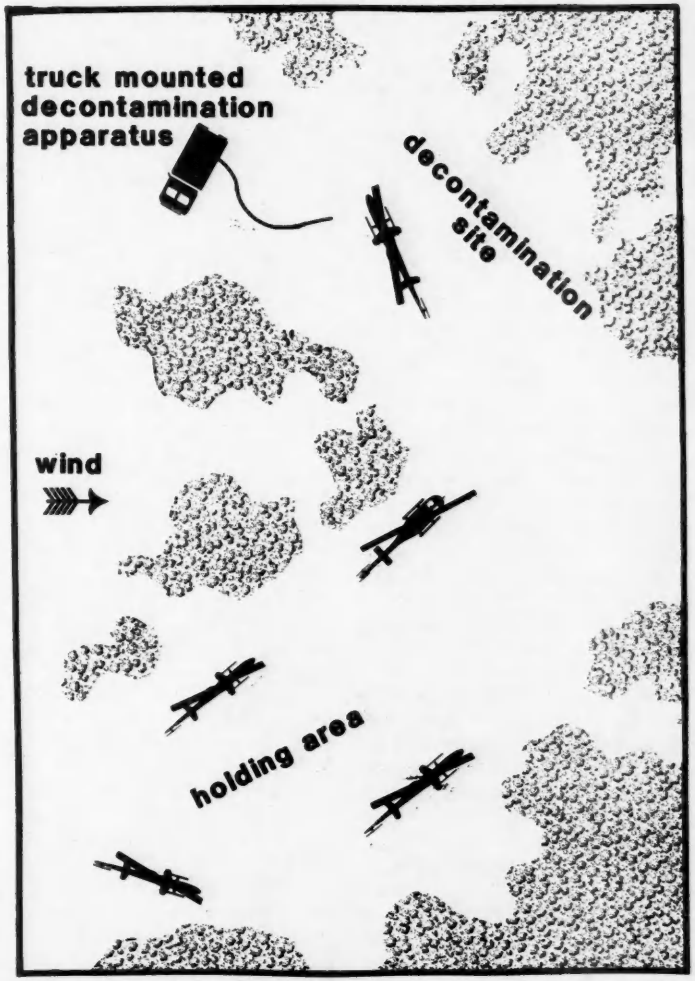

FIGURE 4: Aircraft decontamination, phase I.

Post Decontamination.

Post decon maintenance requires the support of an aircraft's respective technical inspector. On the AH-1 Cobra, the pitot static system is checked for water. For the UH-1 Huey, the tail rotor is purged, the pitot static system is drained, the pylon panels are removed and the forward engine deck is dried. On the OH-58 Kiowa, the fuselage tail boom and attachment fittings are checked for water accumulation. The pitot static system is checked for water. Pylon panels are removed and the forward engine deck is dried. The main transmission and the hydraulic reservoir are checked for water accumulation. Caution must be taken at all times in case of a continued presence of contamination.

NBC Survey and Security Team

The Team: The NBC survey and security team consists of the battalion's chemical officer, a noncommissioned officer in charge (NCOIC), a security team member, and three chemical detection team members.

The battalion chemical officer is responsible for the overall planning and conduct of the NBC survey and security team. The NCOIC ensures that all team members are present for the operation and the required equipment is on hand; plans and conducts the security of the operation; and conducts the ground movement phase of the operation. Team

members perform their survey and security duties.

Preparations: Upon notification of the battalion's movement, the battalion chemical officer coordinates with the S3 and acquires the date and time of the movement, selects the location of the forward assembly area and alternate FAAs. The NCOIC and team members are notified and told the date and time of the mission briefing and the movement plus the equipment to be carried. The team's carry-on equipment consists of three M256 Chemical Detection Kits, NBC Marking Set, IM-174 Radiacmeter, M8 Chemical Agent Alarm and a PRC-77 FM Radio.

The chemical officer coordinates for an aircraft (UH-1 Huey) and with the quartering party officer in charge (OIC) for the brevity codes—"site is cleared," "site is contaminated," "enemy in vicinity," "proceeding to alternate site." The chemical officer and team NCOIC coordinate and plan the mission. Departure of the aircraft with the team is planned to allow a minimum of 1 hour and 30 minutes for the team to conduct its mission prior to the arrival of the quartering party at the FAA.

Actions: The team proceeds to the location of the mission aircraft 30 minutes prior to lift-off. The safety briefing and additional coordination is conducted; the M8 Chemical Agent Alarm and the IM-174 Radiacmeter are set into operation; and weapon functions are checked.

The team boards the aircraft with weapons at the ready to return fires in the event the aircraft encounters hostilities. The aircraft is flown nap-of-the-earth directly to the FAA. One pass is executed as near and over the site as possible while the team monitors for chemical and radiological contamination presence. The aircraft is landed one or two kilometers from the site, or as the terrain and situation permit.

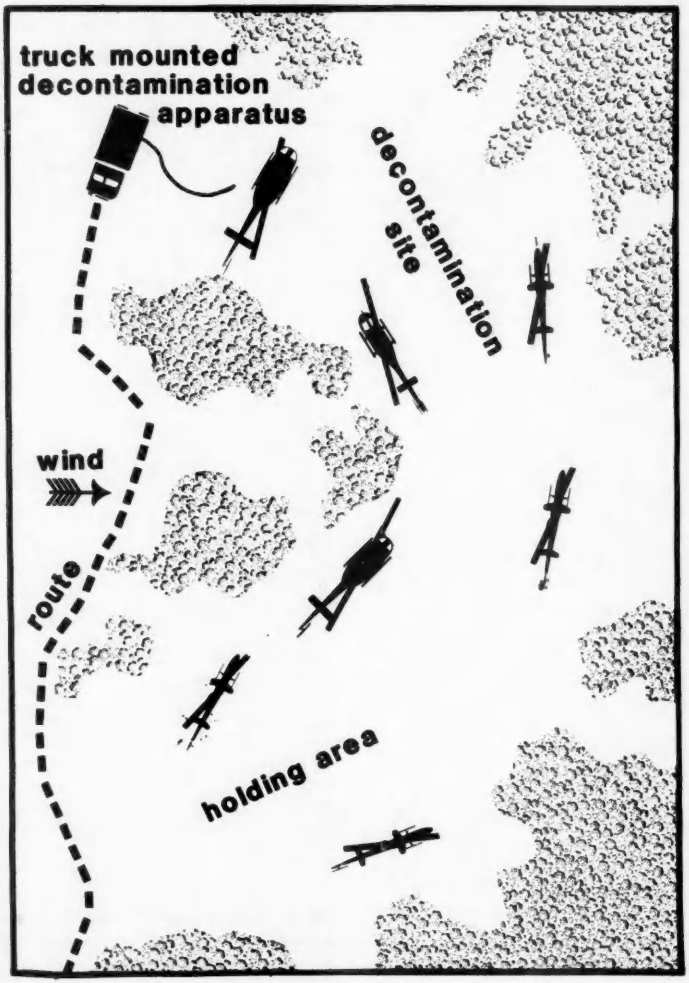

FIGURE 5: Aircraft decontamination, phase II.

Upon landing, the team quickly off-loads and establishes a hasty defense to allow the aircraft a safe lift-off. If necessary, smoke is used to conceal the aircraft's departure. Upon its departure the team quickly reorganizes at the nearest covered and concealed location. It then tactically proceeds to the center of the FAA area and establishes area secu-

*U.S. G.P.O. 1987-189-822

rity from the best overwatch position. Meanwhile survey teams are dispersed to conduct chemical and radiological surveys.

If the area is clear of contamination and hostilities, the team conducts unmasking procedures and, using the prearranged brevity codes, reports its findings to the quartering party OIC. If the area is contaminated, the team reports the fact as above, marks the area with NBC markers and proceeds to the alternate FAA site.

The team reports any hostilities encountered and (depending on the strength of the combatants) attempts to suppress or destroy the enemy force. If it cannot successfully suppress or destroy the enemy, the team advises the quartering party OIC and is instructed to either leave the area or hold and maintain contact until reinforcements arrive.

Once an FAA site is cleared, the team remains at the overwatch position until the quartering party arrives. The quartering party OIC then determines if the level of security should be increased or decreased.

Conceptual Considerations

While developing this NBC defense annex for aviation operations, I considered a realistic battle environment with logistical assets stretched to the maximum. In the April 1986 *Aviation Digest* ["Just Another FM?"], the NBC officer of the 82d Combat Aviation Brigade, 82d Airborne Division, executed an aircraft decontamination exercise as described by FM 1-102. In this exercise he used brigade support assets as well as the support of the division's chemical company. I did not envision an ideal setting during the development of the NBC defense annex for aviation operations. Instead, I foresaw an intense, fast moving battle scenario with the division's chemical company immensely overtasked in providing its support throughout the division's ground maneuver elements. Likewise, I envisioned the division's engineer assets thinly stretched in providing offensive and defensive operations support for its ground maneuver elements rather than sitting in the brigade or division support areas ready to dig drainage ditches for an aircraft decontamination site.

As a result, I developed an aircraft decon site with one station and using only the battalion's decon assets and personnel. I found the single station aircraft decon site favorable over the four station decon site as described by FM 1-102 for several reasons:

- First, the single station decon site is more expedient. It is less time consuming than leapfrogging across several stations. A timely decontamination process is critical. In combat it is urgent to return the aircraft to the commander as soon as possible so they can be refueled, rearmed and returned to the battle.
- Second, the leapfrogging effect produces a significant amount of signature for detection by the enemy. The single station decon site produces little if any signature at all.
- Third, the leapfrogging technique is expensive in terms of fuel consumption. There is an immense amount of fuel consumed with numerous "pitch-pulls." The NBC officer must keep in mind that incoming contaminated aircraft are quite likely thirsty for fuel.
- Last, I found the single station decon site requires less equipment and a smaller decontamination team than the decon site described in FM 1-102. So, the single station decon site is cost effective.

It may be argued that aircraft exiting a single station decon site will become "dirty" as a result of rotor wash. This may occur during takeoff. But, much of this "dirtiness" will be blown off the aircraft while airborne and in forward motion. Any remaining contamination will be eliminated during the second phase of aircraft decontamination I described.

In the case of contaminated aircraft entering a FARP, it is the responsibility of the commander to decide if it is more important to accomplish the mission by rushing contaminated aircraft into the FARP without prior decontamination (risking the spread of contamination at the FARP) or taking the time to decontaminate aircraft prior to entering the FARP (risking the success of the mission).

In the case of aircraft entering a contaminated area, the importance must be weighed between accomplishing the mission while risking contamination to the aircraft—or risking the success of the mission while maintaining contamination-free aircraft.

Increased MOPP level IV will induce efficiency degradation during target acquisition and other functions of helicopters. Risking aircrafts to contamination for the purpose of mission accomplishment does not necessarily ensure mission success.

The development of new effective noncorrosive decontaminants will alleviate the contamination. New decontaminants are being researched, tested and will become available in the near future.

My NBC defense annex may be perceived as nonconforming to present doctrine of contamination avoidance. But, *avoidance at all costs* is not my objective. Rather, I incorporate the concept of *avoidance to the best of the unit's ability* in my NBC defense annex for aviation operations.

ATC ACTION LINE

National Airspace System News

Mr. Lingiam Odems
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On 3 February 1987, the Federal Aviation Administration published a final rule in Volume 52, Number 22, of the Federal Register establishing requirements pertaining to the use, installation, inspection and testing of air traffic control radar beacon system (ATCRBS).

The part that is of most importance to members of the U.S. Army Aviation community is the use and installation of transponders. The major impact on the U.S. Army will be equipping those aircraft flying in and out of terminal control areas (TCAs) with automatic altitude reporting equipment, referred to as Mode C. This rule will address three kinds of aircraft equipment. Below is a description of the differences in equipments and their use.

Air Traffic Control Radar Beacon System. A radar system consisting of a ground interrogator and an airborne transponder. Radar pulses transmitted from the ground are received by the transponder and used to trigger a distinctive transponder reply called a code. There are 4,096 possible ATCRBS codes. The controller's radar receives this reply and displays a distinct and amplified target on the radar scope.

Mode S Transponder. The Mode S transponder is an advanced version of the existing ATCRBS transponder. The Mode S transponder is completely interoperative and compatible with the current ATCRBS. Mode S uses a discrete set of radio pulses (code) for each individual aircraft, has many times the 4,096 possible codes of the ATCRBS transponder. Mode S also adds the capability to provide a two-way data link between the aircraft and the ground.

Mode C (Automatic Altitude Reporting Equipment). Some transponders are capable of automatic altitude reporting (Mode C) with the addition of an encoding altimeter. This special altimeter encodes the aircraft's current altitude to the nearest 100 feet. This encoded information is received by ground equipment and displayed on the controller's scope in the data block for the transmitting aircraft. Mode C may be used with both ATCRBS and Mode S transponders.

The rule as adopted continues to require a transponder for operation in each TCA and in the airspace of the 48 contiguous states and the District of Columbia above 12,500 feet above ground level. Automatic pressure altitude reporting equipment, which is currently required in the above airspace except Group II TCAs, will be required in Group II TCAs, effective 1 December 1987. The rule retains the current exception for gliders above 12,500 feet mean sea level in U.S. airspace, and retains provisions for helicopter deviations; also air traffic control can authorize deviations. The authorized deviation for helicopters is not having an operable VOR (VHF omnidirectional range) or TACAN (tactical air navigation).

The rule provides for a phased transition from ATCRBS to Mode S transponders in the National Airspace System by limiting the manufacture and installation of ATCRBS transponders. After 1 January 1992, all newly installed transponders in the *U.S.-Register civil* aircraft are required to meet the requirements of the technical standard order for airborne Mode S transponder equipment. ATCRBS transponders already installed on that date may be used indefinitely. The number of Army aircraft equipped with Mode S will be limited. This is partly due to the compatibility of the ATCRBS with Mode S, and to the Department of Defense efforts in developing a multipurpose transponder for its aircraft.

Questions or comments concerning this information should be directed to Mr. Lingiam Odems, AUTOVON 284-7796/6304.

Readers are encouraged to address matters concerning air traffic control to: Director, U.S. Army Aeronautical Services Office, Cameron Station, Alexandria, VA 22304-5050.

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